

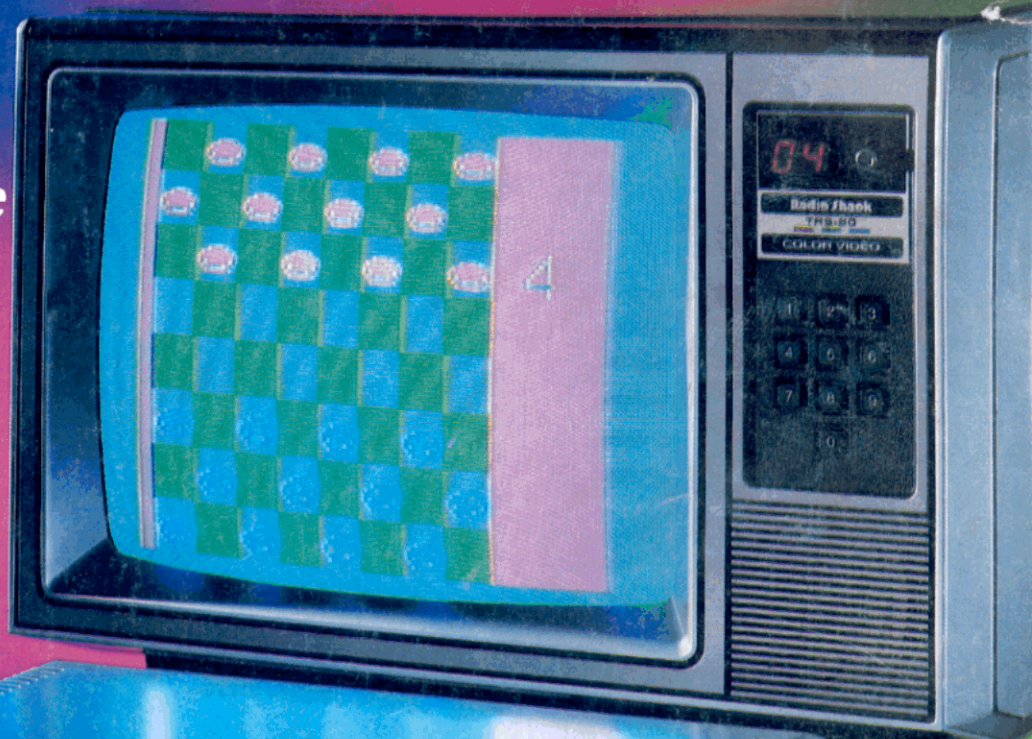
80^{microcomputing}^{T.M.}

the magazine for TRS-80 users*

Tandy Shoots Back with Three New Computers

*Inside 80 gives you
the breakdown on
Tandy's newest
market entries:*

- THE COLOR
COMPUTER
- THE POCKET
COMPUTER
- THE
MODEL III
Page 10



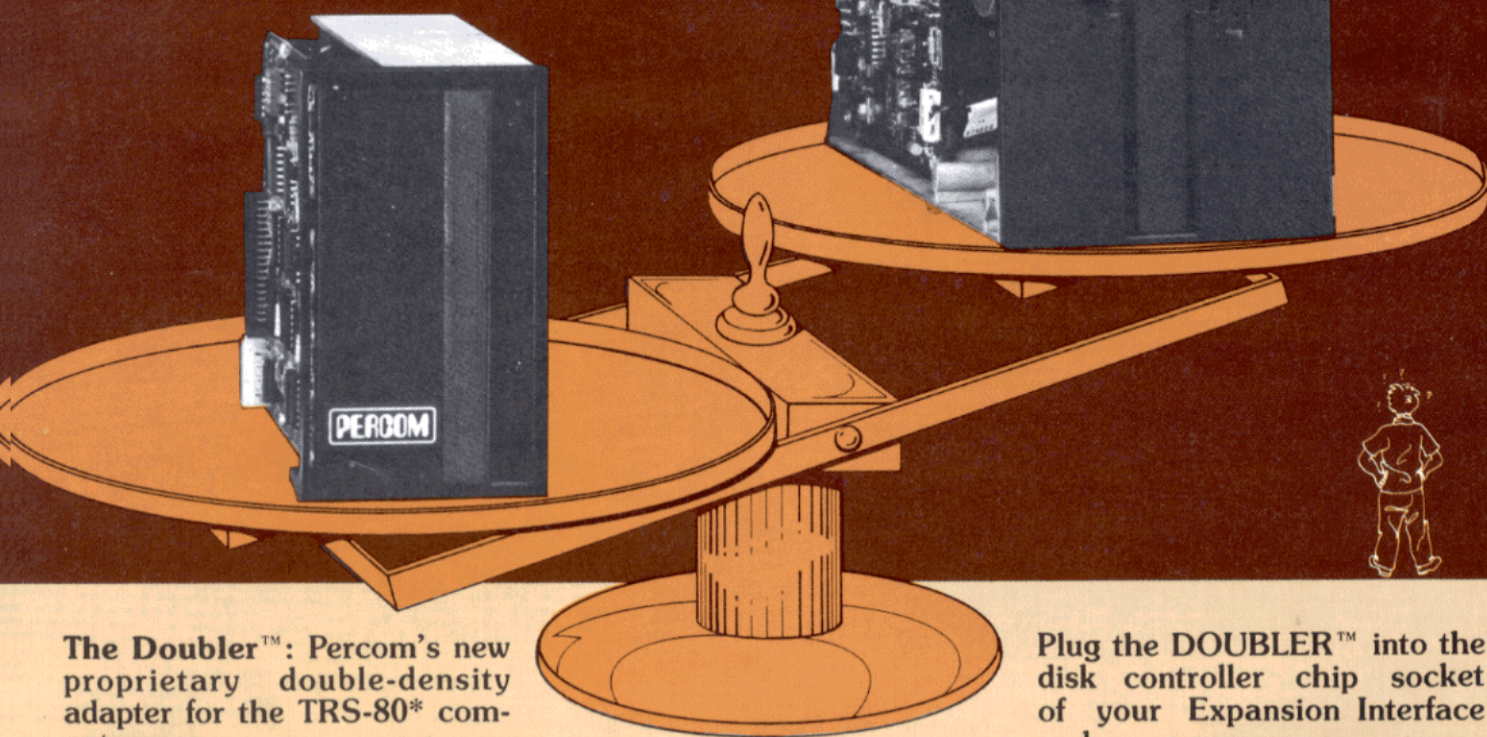
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More than 30 articles, reviews and columns.
Complete contents on page 5.

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to Tandy*



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 - RESTORE FIELD contents.
 - RIGHT-JUSTIFY FIELD contents.
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 - SKIP RECORD (to next or previous record).
- SORTING of records is MACHINE CODE assisted.
 - 200 RECORDS (40 characters) in about 5 SECONDS.
 - ANY COMBINATION of fields (including numerics) with each field in ascending or descending order.
- SELECTION of records for Loading, Updating, Deleting, Printing and Saving is MACHINE CODE assisted.
 - Specify up to 4 CRITERIA, each using one of 6 RELATIONAL COMPARISONS.
 - LOAD or SAVE selected records using MULTIPLE FILES.
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- Full AIDS-III SELECTION capabilities.
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- Prints user-specified fields in titled, columnar REPORT FORMAT, automatically generating column headings, paging and (optionally) indentation.
- Can create a single report from MULTIPLE FILES.
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BELOW ARE TESTIMONIALS from owners of AIDS systems. These are absolutely authentic statements and are typical of the comments we receive.

"This program will do more for my business than all the other programs I have, combined."

David Wareham, Vice President (EDP), National Hospital and Health Care Services Inc.

"We have 32 different Data Base Management packages for the TRS-80. AIDS-III is easily the best. It also makes it easier for us to step up to our Model II since the package is available for both computers."

Jack Bilinski, President, 80 Microcomputer Services

"Your AIDS program is far and away the finest information management system that I've ever seen. I am currently using it to maintain a clear picture of the demographic data on all the kids in our residential treatment program and it is working for me superbly."

Frank Boehm, Director, Front Door Residential Treatment Program

- COMPATIBLE with AIDS-II data files and AIDS subsystems.
- Move up from AIDS-II and EXPAND to 20 field capability WITHOUT REENTERING DATA.
- AIDS-II (Model I or II) owners may UPGRADE FOR ONLY \$25.00.

*WARNING! This program is written in BASIC and can be listed in the normal manner. Modification of program code is NOT RECOMMENDED due to its extreme complexity.

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For Model II \$ 79.95

AIDS

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← **MORE**
PRODUCTS ON PAGE 4

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80 REMARKS

by Wayne Green

"When Radio Shack announced the TRS-80, Ed must have been one of the first to appear at their door to get one."

Here Come de Juge

For many years, one of the top ham stores in the Southwest was Juge Electronics in Fort Worth. Thus, I've known Ed Juge for many years, as a ham and as an advertiser in my *73 Magazine*.

In mid-1975, my frustration with trying to understand and select a computer for handling magazine subscriptions led me to microcomputers. From this interest I developed a plan to put out a magazine for computer hobbyists. Thus was born the idea for *Byte* magazine.

Once I had located someone to edit the new magazine, there followed a frantic five-week period getting the first issue ready to print. Details such as designing and printing the letterhead and envelopes, composing subscription letters, writing possible authors, getting mailing lists from firms in the business, getting in touch with all of the clubs and their newsletter editors, etc., were almost endless.

Then, once the first issue was out, I grabbed a bunch of copies and flew to visit the major firms in the business to show them my new magazine and get their support. I visited Mits, the pioneer microcomputer firm, then Sphere. On my way down to San Antonio to see Southwest Tech, I stopped off in Dallas and drove over to Ft. Worth to say hello to Ed Juge. I talked with Ed enthusiastically about the future and what I saw as an industry which would have to grow very rapidly.

Apparently my enthusiasm did the trick, for Ed quickly sent away for an Altair and started in microcomputing. When Radio Shack announced the TRS-80, Ed must have been one of the first to appear at their door to get one. By this time he was out of the ham business.

The ham business was a real bummer during the 1964-1974 period, as a result of a proposal by the American Radio Relay League to change the ham regulations in a way that would take enormous frequency bands away from most hams. Sales of ham gear dropped to about 15 percent of their previous level and about 75 percent of the ham stores around the country quit the business. Not long after my visit, Ed got fed up with the slow ham sales and with most of the ham manufacturers going out of business (we lost Hallicrafters, National, Hammarlund, Barker & Williamson, Johnson, Harvey Wells, Multi-Elmac, World Radio, Galaxy—virtually every major ham manufacturer) and folded up his ham business. For a while he was manufacturing a fold-away mobile mount for car antennas and do-

ing well. But the micro bug had bitten.

It didn't take very long for Radio Shack to discover this sharp chap right in their backyard. Eventually Radio Shack lured Ed out of retirement and made him director of computer merchandising. That was one of the wiser moves made by Radio Shack. Ed is one of the reasons that Radio Shack has been able to move a bit faster than most of the other firms in the field.

I'm happy to have Ed writing a column for *80* and thus give all of us TRS-80 owners a look at what is happening in that otherwise very secretive Tandy Tower in Fort Worth. It will be a relief to get some honest information on what is happening and what may be in the works. The general tendency of large firms is to deny all rumors up until a new product is ready for sale. This is frustrating, particularly in a fast moving field such as microcomputers.

Tandy in Europe

Just in case you are under the impression that Tandy is not pushing hard in Europe, here is the back cover of their recent catalog distributed in the Netherlands. That price translates to about \$855 in U.S. funds at the

current rates, not a lot more than the U.S. price, considering the problems of shipping, duty, service and other distribution costs.

We stopped to visit a major Tandy store in Rotterdam and sure enough, they had a TRS-80 on display. We talked with them about getting some of our TRS-80 programs translated into Dutch and they put us in touch with a local programmer who was most interested. I think we'll be coming out in one more language in short order, if anyone wants to brush up on his Dutch.

The Belgian price translates to about \$866 at the current exchange rate, again a very reasonable price for the system when you figure all the expenses involved in supporting the system in a small country like that. The problems are somewhat simplified by the use of French in the catalog, but I suspect that most programs are still in English.

As we were driving through a very small town in Belgium, Malmedy, about the size of Peterborough, N.H. (population 5,000), Sherry spotted the Tandy store and we stopped.

We had a pleasant visit with the chap running the store and found that even in a town this small he was selling an average of two or so TRS-80 systems a month! We showed him some of the Instant Software packages we had

Continue to page 11

Tandy's Catalogs Distributed in the Netherlands and Belgium



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INSIDE 80

by Ed Juge, director of
computer merchandising, Tandy Radio Shack

"To those among you who didn't like TRS-80's modular design, and said we aren't responsive to our customers—may you byte your tongues."

Since I promised last month to tell you about some new products, you're expecting me to finally admit the TRS-90 rumor, aren't you? We heard so much about that here in Fort Worth that we *almost* used TRS-90 as a code name for one of our new computers.

TRS-80 Color Computer

I'm writing this prior to any announcements; bear this in mind when I say, we are about to announce our new TRS-80 Color Computer! The Color Computer attaches to any color TV—yours or ours. A video modulator is built-in, and radio frequency interference (RFI) shielding is excellent.

The screen is 16 lines deep by 32 uppercase characters across.

Color graphics are available in five formats from 32 times 64 pixels with eight colors, to 196 times 256 pixels with one color plus background. The Color Computer also offers sound.

The keyboard has 53 keys. Although they are smaller than those on professional keyboards, they are in the normal staggered typewriter layout. The processor is an MP 6809E.

The low-end Color Computer comes with 4K

RAM and an 8K ROM BASIC. Two joystick ports and an RS-232-C are built-in. Although a recorder is optional, a cassette port is provided for program and data storage at 1,500 baud (not compatible with our non-color TRS-80 software). There is also a port for ROM plug-in Program Paks and GO programs, which can include up to 16K of additional ROM.

Expansion options will include up to 16K RAM, which is required for some of the higher resolution graphics modes, a 16K extended BASIC, the joysticks, communications, printers and a disk drive.

Everything won't be available immediately. For example, the extended BASIC is expected in late November, and the disk drive in early 1981. Joysticks should be available by press time. The existing Quick Printer II already has a serial interface, and its 32-character lines match the Color Computer's format.

TRS-80 Color BASIC is more powerful than Level I and compares favorably with Level II. It includes commands for input from the joysticks, for color video, and for sound output. PEEK, POKE and USR(0) are included for the serious programmer. Accuracy is to nine digits. String handling, arrays and func-

tions (ABS, INT, RND, SGN, SIN, SQR) are also included.

Besides higher resolution in graphics, TRS-80 Extended Color BASIC adds rotating and zoom movement to your graphic blocks. You'll also get editing, tracing, specific error messages, user-definable keys, additional intrinsic functions and real-time clock access from BASIC.

I'll bet about now you're saying to yourself, "Just what the world needs—another thousand-dollar color computer!"

Not quite. The basic computer will sell for only \$399. The 16K RAM kit is \$119, and the Extended ROM for another \$99 plus installation charges. In late November a 16K Extended Color Basic computer will be available.

Because the new color computer utilizes a different kind of chip in ROM, it requires its own software. Initially, eight ROM Program Paks will be available from Radio Shack: Personal Finance, Quasar Commander, Checkers, Chess, Music, Math Bingo, Pinball and a diagnostic pack to check memory and functions. Several more are being developed.

The Model III

The smoke from our Color Computer did a fair job of covering up another new project. To those among you who didn't like TRS-80's modular design, and said we aren't responsive to our customers—may you byte your tongues.

There is now a bridge between the Model I and Model II. There is now a TRS-80 Model III!

A single housing contains a 12-inch high-resolution video monitor, 65-key professional keyboard with a 12-key datapad, computer and power supply (with only one power cord).

Model III will expand quite far without going outboard. You can start with the familiar 4K, Level I system at \$699, which is software compatible with existing Level I cassette programs. (The recorder is not included.)

Additionally, Model III Level I includes print commands to take advantage of Model III's parallel port. The processor is a Z-80, at 2.0 MHz.

One kit can be used to upgrade Level I to 14K extended Model III BASIC and increase 4K RAM to 16K. From there, RAM increases in 16K jumps to the maximum of 48K—all internally.

Model III BASIC offers two cassette speeds: 500 baud which is compatible with existing Level II programs; and a new reliable 1,500 baud mode. An expanded character set including upper- and lowercase is standard, as is a screen print function in ROM. Also, the

TRS-80 Color Video and Model III



BREAK key will now exit from a hung-up LPRINT or CLOAD—or any other lock-up.

There is a real-time clock, accessible from Model III BASIC or machine language. Also, an RS-232 board can be added inside the Model III.

Two internal disk drives can be added. The 5¼-inch drives are 40-track double-density drives, giving 178,944 bytes per data diskette (about 134K user space on drive 0). Two more drives can be added externally, for a total of four, and almost 600K of on-line storage. With two drives, single-density Model I disk software can be converted to Model III disks.

All Radio Shack software, and most non-Radio Shack software for the Model I should be compatible. Three Model III versions will be sold: the 4K Level I for \$699, the 16K Model III BASIC for \$999 and the 32K two-disk RS-232 system for \$2495. Other system configurations must be reached by installing upgrade kits.

Model III TRSDOS will contain all of the features of the Model I and many of those of the Model II DOS. It includes a BUILD command to create a DO file for automatic power-up command sequences. HELP gives you detailed instructions on any specified command. SETCOM initializes the RS-232 port, and CONVERT reads a Model I disk and converts its programs to a Model III disk and Model III format.

We've gone overboard to maintain compatibility with Model I programs. We also kept Model I's 16-line by 64-character video format, in the interest of compatibility. There are strong arguments for others formats, but we feel the compatibility of existing software is most important. We expect some vocal objections, but hope our choice reflects the choice of the majority.

The Pocket Computer

This year at Radio Shack good things are coming in threes. Our third new product is the TRS-80 Pocket Computer! That's right—a pocket-sized TRS-80.

It programs in BASIC, has a 24-character liquid crystal scrolling display, features ten-digit numeric accuracy, with exponential notation to plus or minus the 99th power of ten. It includes 1.9K of memory for program and data storage, which stays live even with power switched off. Program steps are stored in a compressed format that packs more commands into available memory than you will believe!

An automatic power saver feature turns the power off after 7 minutes of inactivity in case you have forgotten. An optional cassette interface allows external program and data storage.

The keyboard contains 57 keys, including an alphabetic keyboard in typewriter format, numeric keys in calculator layout and special functions. Eighteen of the alphabetical keys can represent reserved functions when used with the SHIFT key. Four type 675 mercury batteries (non-rechargeable) provide a nominal life of 300 hours.

The Pocket Computer can be used like a calculator. Formulas are input using parentheses and symbols, as you would on paper, rather than one operation at a time in typical calcula-



TRS-80 Pocket Computer.

tor mode. After an equation is solved, it can be recalled and edited.

We have seven programs already available for the Pocket Computer—with more to come. Or you can write your own BASIC programs. The Pocket Computer contains 11K of ROM, including a 7K BASIC and 4K monitor.

Pocket Computer BASIC is much like Level I. But it includes 15 arithmetic functions and no graphics. It allows limited string variables (up to seven characters), and limited string and numeric array variables.

The memory, which holds 1424 steps, is automatically partitioned for program and data storage. There is a 26-data element memory

and a 48-step reservable memory for storing frequently used functions. This six-ounce beauty is a true TRS-80—not just a programmable calculator with alpha capability. When you've tried one, I predict you'll give your programmable to "Junior" to play with!

Well, I hope I've excited you. Obviously Wayne doesn't want me taking up the whole magazine.

Let me close by saying, once again, that as Radio Shack brings out new products, we don't intend to forget purchasers of our first TRS-80s. We intend to continue to support all models with new software and hardware products. ■

80 REMARKS

From page 8

for his system and he felt that if he had them available to help him, his sales would increase dramatically. Tandy stores are not yet permitted to sell any products not stemming from Tandy. ■

Twentieth Anniversary Issue

With the twentieth anniversary issue of *73 Magazine* (my first publication in the ham radio field) going to press, I find myself reflecting over the ups and downs of the past twenty years.

My ham magazine, like *80*, is for me a labor of love more than a way of making money. Amateur radio is beginning to grow again and there are some exciting prospects. Many of the changes I see coming in radio are tied to microcomputers and the circuits which microelectronics make possible. For those of you who have not yet been bitten by the hamming bug, I might explain that most of the important inventions and pioneering developments in radio communications have been made by amateurs, and there is no reason why this won't continue.

The list of ham developments is a long one—slow scan television, virtually every radioteletype circuit being used today, circular anten-

nas, etc.

The pioneers of commercial television were amateurs too. I worked in the TV broadcasting industry back in the early days (1948-1950) and many of the people I worked with were graduates of W2XEL, an amateur television station out in Queens, NY.

Today, we are in the early days of microcomputers, and we are seeing most of the inventing and pioneering again being done by amateurs. This is one of the exciting aspects of this magazine. It is a medium for keeping everyone in touch with the latest ideas and the state of the art. People who depend on reading books are a year or more behind what is happening because it takes that long before books are published. Meanwhile, the art is staying ahead of the books and is reflected in magazine articles.

The art, in our case, is microcomputing—its hardware and software. In the hardware line we see improvements in the basic computer unit (CPU), in memories, in mass storage equipment such as disks and various tape systems, bubbles, in printers, modems, control systems. In software we are seeing continuous improvements in languages, in operating systems, and in applications programs of all sorts.

The basic purpose of *80 Microcomputing* is to let you know what is going on in all of these aspects. We aim to make the material as understandable as possible, and we are making a major effort to see that we have plenty of information to help the rank beginner grasp the fundamentals. But we also want to act as a medium for the front runners to communicate and let all of us know what is going on up there. ■

80 INPUT

"...if you have a new set of ROMs at power on... The computer will ask MEM SIZE instead of MEMORY SIZE."

Shack Service

I was amused by a recent local advertisement for Radio Shack Computers that said, "We service what we sell." As a dealer in business systems, we are naturally interested in that line of equipment and purchased a Model II, primarily to get acquainted with it and find out just what using and supporting it involved. We found out.

First of all, it was DOA from a bad memory chip. We broke the seal as part of our self-imposed indoctrination and luckily had a chip on hand from a previous job. The next failure involved the CRT sweep circuitry, and we dug in to it again.

It turned out that the part we suspected (horizontal drive amplifier) had a house number that did not cross-reference to anything. It was then that we learned that Radio Shack stores are not permitted to stock parts for these computers, and that Tandy's standard advice is to send the entire machine to the nearest service center, roughly 600 miles away. That center verified that they were not authorized to service boards or sell parts.

Another call on the hot-line gained us the names of three other cities having service centers, but no names, addresses, or phone numbers. We did locate them through phone directory assistance, and eventually found one that would accept a board for repair.

The repair was prompt and well done, at a reasonable price. The fix, as nearly as we could determine, consisted of changing the value of several resistors. This apparently prevents instability when the drive is low, which was the case in our machine.

In summary, we can only tell our customers that yes, Radio Shack does have a service capability, but it is somewhat difficult and time-consuming to obtain when you need it.

*E. G. Brooner
Lakeside, MT*

Satisfied Subscriber

I am just writing to you to express my gratitude for your magazine. It is a truly superb publication, and I plan to subscribe to it for a long time to come. We get a few other TRS-80 related publications, but yours is the best.

Just the other day I received as a gift the Radio Shack Editor/Assembler and I have started learning assembly language.

I looked over my first issue of *80 Microcomputing* and was again amazed at the amount of useful information supplied to the reader. You

wrote in that issue, "...The editor of *80 Microcomputing* is not trying to impress you with his great knowledge of computers, I just want to provide you with entertainment, a way to learn more about your system, a way to save money on developing it." I believe you have done just that. Please continue to publish the fantastic magazine that you do.

*Brad J. Richter
Ridgefield, CT*

Multiple INKEY Entry

Entering more than one digit or character by means of the regular INKEY routine is not possible, since the system reacts to the last character entered. Using the INPUT routine displays a query symbol and also requires ENTER to be pressed: In my opinion, this is for the birds in any reasonable operator/machine interface.

The following routine permits two characters to be INKEYed:

```
100 GOSUB 500
110 BS=AS:AS="":PRINT BS;
120 GOSUB 500:PRINT AS;
500 AS=INKEYS:IF AS="" THEN 500 ELSE RETURN
```

Line 110 stores the first INKEY as BS, and resets AS to a null. This requires that two characters *always* be entered, e.g. 01 for 1, etc. The routine can be expanded for additional input if required.

The input can be restricted to digits only by modifying line 500:

```
500 AS=INKEYS:IF AS="" THEN 500 ELSE IF ASC(AS)<48 OR ASC(AS)>57 THEN 500 ELSE RETURN
```

Any non-digit entry will be ignored.

*Michael Barlow
Pierrefonds, Quebec
Canada*

New ROMs

Did you know that Radio Shack has new ROMs in the latest models of the TRS-80? In case you don't I will tell what little I know and problems and fixes I have found.

First, Radio Shack did a software fix for the cassette loading problems. It works wonderfully!! Second, they added a control key which is the shift, down arrow. Therefore, shift, down arrow G will send a CHR\$(7) or what is known as a bell. This works for all 26 keys. However,

if you are using NEWDOS the shift, down arrow no longer works for the last program line, but shift, down arrow Z will, for the old code for shift, down arrow was 26.

You can determine if you have a new set of ROMs at power on. The computer will ask MEM SIZE instead of MEMORY SIZE. The second message will use R/S for Radio Shack. The keyboard will also have the new keyboard which is a wonderful improvement in itself.

I hope this information may be helpful to you. Also page 0 calls are all the same for other calls I don't know. Radio Shack will only say the calls listed in the editor/assembler are in the same place.

*Chess McKinney
Hermitage, TN*

Scriptit: Round Three

Perhaps I should not say anything, not having tried the Electric Pencil WP program, but since I saved about \$50.00 by buying Scriptit, I figure I have two cents I can spare to stick in here.

In his letter to 80, Peter Brennan seemed somewhat incensed at Scriptit for a few of its shortcomings. Let me simply remind him in a blanket approach that Pencil was not written for the TRS-80. It is available for many machines and has probably undergone changes (for the better) as it metamorphosed.

More specifically, let me address myself to what he mentions as defects and see if we can't shed some light on them.

I am using Scriptit with a Teletype 43 until my 737 arrives. Mr. Brennan is correct, the program assumes the printer will supply a line feed with the carriage return. The only formatting problems I have run into using my 43 is that double spacing requires using the LS=3 command rather than LS=2.

Yes, it does play havoc with page length, but, and perhaps there is some other difference between the printers we use, I find that the page length setting should be full scale at 90, not the 75 he suggests, and the bottom margin somewhere around 86, again, not the 70 he mentions.

The paragraph formatting is simply set to the same dimension as the line space. Granted, one must then print the text using the (P)pause option, but I picked the printer, as I assume he did, and I knew full well what its limitations were in regard to its compatibility with my TRS-80 and the printers Radio Shack suggests for it.

I also have those sheets of paper Tandy claims will enable Scriptit to use "my own

driver." I also have no idea of what to do with them. I think his condemnation of Tandy might have been modified to read, "You should have bought a Radio Shack compatible printer," and in this instance they are right. You don't spit in the wind and you don't pull the mask of the old Lone Ranger. That only makes sense.

I can't vouch for the ability of the Pencil to keep up with the pace of typing, but it's definitely not true that Scripsit will keep up with a fast typist. I am not the fastest, but there are times when the program will not keep up with me, and times, since it allows continuous character print by holding down a key, that I get multiple characters when I don't want them.

I have typed some 90 pages using Scripsit, which makes me no expert in its operation, but I think the bulk of Mr. Brennan's comments might be clarified by concentrating on using Scripsit and discovering its finer points, rather than trying to play it off against Pencil. I would have rather he mentioned that selecting a particular spot in the text for printing requires re-entering the format instructions. That's an inconvenience, but that's about the only thing I can come up with that bothers me.

Scripsit is easy for me to use. After the first half hour of the tutorial cassette Tandy supplies I shut my deck off and started using Scripsit with the foldout of operating commands in front of me. I guess the decision as to which program depends on the matter of application, of use and of oneself.

William O'Brien
New York, NY

Micro Mystery

I am returning the Microsoft editor/macro-assembler/linkage-editor to my Radio Shack dealer because of totally inadequate documentation.

There is absolutely no discussion of concepts. How is the average Level II BASIC midnight coder supposed to know the difference between an assembler, a compiler, and an interpreter? How is he/she supposed to know what a macro is? How is he/she supposed to know the power and flexibility of a linkage-editor?

Being a multi-lingual independent commercial programmer, I have worked on most 3rd generation computers, including everything made by IBM. I am used to IBM manuals that deal with concepts prior to discussing bit-fiddling. Microsoft people have obviously never seen an IBM manual, which has wonderful little aids like examples, concept discussions, sample programs, graphs, hints, references to other manuals, etc., all of which are totally lacking in Microsoft's piece of literature which I am hesitant to call a manual.

User response prompting is non-existent. When the editor, assembler, or linkage editor are executed, they simply display an asterisk on the screen. If I wrote programs like that in industry, I'd be fired on the spot. How about prompting the user to enter the source file name, the object file name, the load address, the number of object modules to be linked, do I

want a cross reference, etc., etc., etc. I'm totally underwhelmed by their kindergarten code.

Can this manual really be from the same folks who gave us the Level I and Level II (w/o index) manuals? Why didn't Microsoft contract with David Lien to write their assembler manual instead of the incompetent trainees they used?

Dave Westfall, Pres.
Aries Computer Software, Inc.
Farmington Hills, MI

You are right, of course. I would perhaps be more critical of Microsoft if I had had any success in the last four years in getting an article written for any of my magazines which covered the material you are asking about. I have been promised dozens of times by writers that they would do this... and so far not one promise has been kept.

The difference between an interpreter and a compiler is a very difficult concept for both beginners and intermediate computerists.

This applies to macro anything, linked editors, and the lot. With the execution of the instructions which come with the Level I TRS-80, I would be hard put to point with pride to good documentation in our field. I can point to any number of ghastly disasters. — Wayne.

Tired Memory

If you're tired of continually having to reserve memory for your commonly used machine language routines, or if you have more than one and have to figure out how much to reserve, you can let the 80 do all that for you by using the method shown in the listing below.

```
50 CLS
200 DEFINT A,I
300 DIM A(8)
500 FOR I = 0 TO 7
550 READ A(I)
700 POKEVARPTR(A(0)) + 1, A(I)
800 NEXT I
1000 DATA 62,49,50,32,62,195,154,10
1200 DEFUSR = VARPTR(A(0)):X = USR(0)
1400 AS = INKEY$:IFA$ = "" THEN 1400 ELSE STOP
```

Simply answer the MEMORY SIZE? with an <ENTER> and append the appropriate data statements to your program. The data in the program (line 1000) prints a 1 in the center of the screen.

The key to the program is in line 700 where the data in line 1000 is POKED into memory, starting at the location where the array A begins. By setting the DEFUSR to that starting location and executing the USR, the 80 will perform the machine language steps and return to your BASIC program. For your routines, just replace the data statement with your data and change line 500 accordingly. Line 1400 was inserted so you can admire your handy work. Note that you can have several machine language routines.

A word of caution is needed. Since the 80 has a habit of rearranging its memory from time to time, the starting location of the A array may change. For this reason, it is necessary to reset DEFUSR each time the USR is called. I would

recommend carrying statement 1200 as a compound statement any time you need your machine language routine.

A. W. Maddox
Creve Coeur, MO

Simple Debounce

In the April issue of the magazine, you have an article written by C. W. Anderson which shows a relocation routine for the KBFIX routine. In this article the author makes a request for a debounce routine which only contains relative jump instructions. For some months now I have been using a debounce routine that can be directly located anywhere in memory, but which normally will not require relocation.

In my TRS-80 which does not have an expansion interface, the reserved RAM area from 405E to 407F does not seem to be used by any of the routines in ROM. Thus if a routine can be fitted into this area, then it can remain untouched during execution and the addresses in the high end of RAM can be used for other purposes. Since KBFIX apparently requires 55 bytes it won't fit in here, but there are fortunately less memory-consuming methods available. The method I am using requires 22 bytes of permanently allocated RAM, and will therefore easily fit into this area.

The extra instructions required to initialize the routine are only used once, and can therefore be placed in an area of RAM where they may be erased at some later stage. The most convenient area to use for this purpose is the I/O buffer area from 41E6 to 42E6. As long as the buffer is not used during the initialization process, the area is perfectly safe to use for such purposes.

The debounce routine may seem a little primitive, but during several months of use it has not let me down once. During normal processing it is even slightly faster in execution than the routine in ROM since it does not require as many instructions to determine whether the keyboard status has changed. When the status does change, however, a delay loop is invoked causing a delay in processing.

I can add that when I use the TRS-80 without the routine, there will be a repeated character on nearly every line, despite clean keyboard contacts.

The 22 bytes of permanent code are as follows:

```
406A 118038 LD DE,3880H
406D 213540 LD HL,4035H
4070 NXTCH:
4070 CB03 RLC E
4072 F8 RET M
4073 2C INC L
4074 1A LD A,(DE)
4075 AE XOR (HL)
4076 28F8 JR Z,NXTCH
4078 0605 LD B,5
407A CD6000 CALL 0060H
407D C3E303 JP 03E3H
```

The value loaded into B in line 4078 could possibly be changed to 4, 3 or 2 thus reducing the delay time, if this still provides adequate debounce.

The only purpose of the initialization routine is to put the starting address of the debounce routine into the keyboard DCB. Unfortunately this cannot be done in BASIC with POKE since the address is in constant use during execution and should therefore be done in an uninterrupted sequence of instructions or in a single instruction. The following lines can be used, at the same time setting the USR address back to the default value.

```
42D0 216A40 LD HL,406AH
42D3 221640 LD (4016H),HL
42D6 214A2E LD HL,2E4AH
42D9 228E40 LD (408EH),HL
42DC C9 RET
```

I use a short BASIC program to POKE these values into memory, call them with a USR(0), and then issue a NEW statement. I was also pleased to see in the April issue that others have found out that BASIC can be used to convert values from hexadecimal to decimal for the POKE statement (MACROPOKE monitor). It certainly saves a lot of conversion work and potential errors. Actually I use a format which includes the address at the beginning of each line, with the data bytes following, for example:

```
DATA 42D0,216A40 221640 214A2E 228E40 C9
```

Intervening spaces can be used to separate the individual instructions, making them even easier to interpret visually.

Obviously, since I have neither expansion interface nor a disk system, I cannot guarantee that the area used for the debounce is also unused when these are added, but for users without these extras (presumably still the majority) it should provide a trouble-free debounce that doesn't require MEMORY SIZE or interfere with other machine language routines.

Arne Rohde
Pilevej 31
7600 Struer
Denmark

Box Confusion

Thought your readers would like to know changes necessary to make "Ball Box" (April 80) work in Level II, since they are elusive and not covered in text.

- 1) PRINT AT in Level I can be followed by a comma or semicolon. PRINT@ in Level II must be followed by a comma, NOT a semi-colon. Therefore, add a comma before the semi-colon in lines 2010, 4900, 4920 & 4940.
- 2) POINT returns -1 in Level II, not 1 as in Level I. Therefore, add a minus sign before 1 in lines 4320, 4330, 4410, 4420, 5020 & 5120.
- 3) No graphics wraparound in Level II, so change line 5001 to Y=RND(48-4)+2 or you will get a FC (function call) error, line 5020 frequently (whenever Y>47).

Fred Blechman
Canoga Park, CA

Like Father, Like Son

I am 13 years old. I think that *80 Microcomputing* is one of the best books about microcomputers. My dad subscribes to it, and we both enjoy it.

I like the articles and columns that you have

printed. It has very interesting stories and programs, we both read and like this book very much.

Thank you for making such a fine product.

Martin Eisenhauer
Margate, FL

DEBUg

Error in SCRNPRT

A small error in my SCRNPRT program in the May issue of *80 Microcomputing* got past me and effectively disabled the instruction that fools the computer into thinking that its RAM ends just below where SCRNPRT starts. When working properly, this instruction both protects the program against TRSDOS Disk BASIC's usage of the top few bytes of memory and obviates the need for answering MEMORY SIZE. Unfortunately, I left off the H in the instruction, so the program attempts to change a ROM decimal address instead of the correct RAM hex address. This would not have caused a problem in the program as printed, since it was assembled lower in RAM, but would cause a conflict with BASIC if the program were assembled at the very top of memory.

To correct the error, change the fourth through sixth bytes of the assembled program to 224940 instead of 22D10F, and change the corresponding instruction to read LD (4049H),HL.

My apologies to anyone who may have been inconvenienced.

Louise H. Frankenberg
Pasadena, MD

More Story

The addendum at the end of the text, "Get the Whole Story" (July 80) is not clear. The programs printed in the article are current, except for the Order Verification Program (Listing 1). This program requires frequent price updates. The cassette/wafer offered for \$25 includes the latest high-speed order verification with the prices in data in effect at the time of shipment. Those who order the whole package for \$25 may receive updates of the order verification program on cassette or wafer for \$10.

Program Listing 3, Bookkeeper, has an omission that will create a serious error. Line 340 should have.....J1=0..... added.

I'm also including a suggested correction to the monthly Gross Profit Statement (Listing 4), which will allow a much simpler method of providing a printer option.

With over 160 magazine articles published, I've never had such enthusiastic reader response as I've had to this one!

Fred Blechman
Canoga Park, CA

```
CHANGE LINE 10 TO.....CLS:PRINT:INPUT"PRINTER? (Y/N)";A$
ADD LINE 11.....IF A$="N" POKE16423,4
ADD LINE 12.....CLS
CHANGE END OF LINE 31 TO.....GOTO99
DELETE LINES.....50,60,70,75,86,90,92,93
```

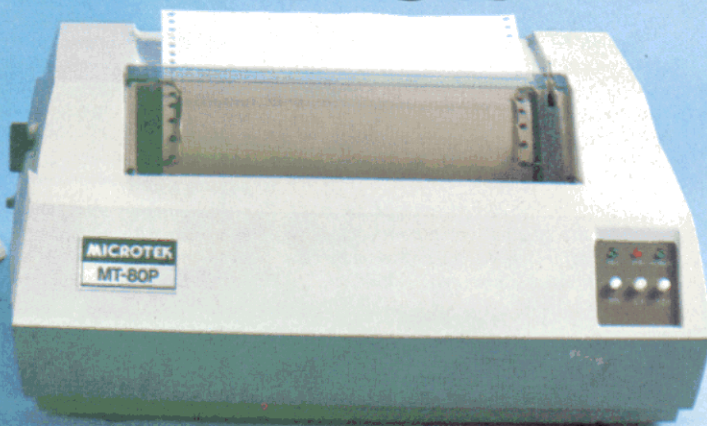
```
IF YOU ANSWER N TO THE QUESTION IN LINE 10, THE COMPUTER
WILL IGNORE ALL LPRINT STATEMENTS, AND YOU'LL HAVE SCREEN
DISPLAY IN THE ORDINARY WAY. TO ENABLE LPRINT AGAIN, JUST
POKE16423,5. NOTE: IF YOUR PRINTER NEEDS A SOFTWARE
DRIVER, PRINT PEEK(16423) AND NOTE THIS VALUE WITH THE
PRINTER DRIVER ACTIVE. THIS WILL THEN BE YOUR POKE VALUE
TO ENABLE PRINTER AFTER DISABLING WITH POKE16423,4 .....
```

Monthly Gross Profit Update



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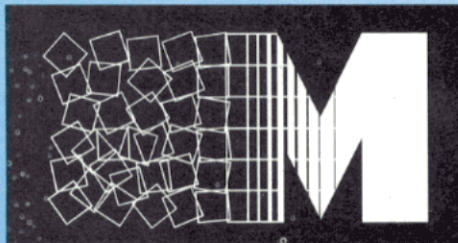
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Disgruntled Manufacturer

There might have been some confusion about the thrust of John Acres' article, "Saving Money," that appeared in the July issue of 80. The piece raised havoc at Microtek in San Diego.

Acres' piece in no way purported to be a review of Microtek's product or of the Percom drive mentioned. It seemed more of a caution to enthusiastic hobbyists not to let their affections for the hobby elude their better judgement. The Moral: Always read the manual.

Though 80 does not intend to shy away from controversy, we regret the lost energies on an article that apparently was misconstrued by some readers. The intent of the Acres article appears to our editors to satirize his own electronic abilities or lack thereof.

To help set the record straight, we're re-printing the original correspondence from Acres to Microtek, forwarded to us by Dan Obed, Microtek's president.—Eds.

Microtek:

Enclosed are the remains of a once-proud

Microtek printer that I killed by my own hand. Bad as that may sound, I am also responsible for the death of two Radio Shack disk drives, one Percom TFD-200 disk drive, a TRS-80 expansion interface and—perish the thought—a TRS-80 keyboard unit.

It was not cold-blooded murder though, it was an accident I swear! In my haste to see the Microtek unit in action, I used a Radio Shack number 26-1401 printer interface cable—the one normally used with the Centronics 779-2.

How was I to know that the Microtek has a separate signal and chassis ground (without having read the manual)?

Unfortunately, the interface cable mentioned above connects pin 17 to the signal ground of the TRS-80 expansion interface while deviously allowing the printer to function, giving no indication of the danger lurking ahead.

Although my intentions were good, I was overcome with the lust of a working system and—in a moment of insanity—disconnected the three-prong grounded ac plug of the TFD-200 from ac power. Somehow in that mysterious electronic twilight zone when an ac plug is somewhere between con-

nected and disconnected, a ground loop (or something!) got onto signal ground and caused 5 ICs in the TFD-200 to explode and several pc traces to vaporize.

Similar damage was done to the TRS-80 components. As for the Microtek printer—alas—it too had its luscious circuitry violated. The pc trace to pin 17 of the parallel interface connector evaporated. And that's not all. The 8155 seems to be very ill. When connected, it pulls the +5 volts to a helpless 3.2. Whatever ails it is contagious. When a known healthy 8155 is plugged in, it too soon develops identical symptoms. Without the squiggly diagrams outlining circuitry connections, further surgery on my part is fruitless.

I appeal to you then: Ye mellow, laid-back gods of California heal this printer and return it to me as quickly as possible. Charge me what you will—but do not make it over a hundred dollars without talking to me first.

If they have not been sent already, please send along a ribbon and spools. They were not included with the printer originally.

John Acres
New Palestine, IN

80AID

Teletype Interface

I have an old Model-15 Teletype Printer (with a 5-bit code and 60mA current loop) that I would like to use with my Radio Shack TRS-80 Model II. Unfortunately, Radio Shack has nothing that could or would help me concerning this type of operation. Please! Can you help me?

Milton J. Belle
2008 Wayside Street
Compton, CA 90222

Friden Schematic

Could you please print the following inquiry wherever it is appropriate?

I am looking for a schematic or information on the Friden Flexowriter Programmatic Typewriter. I have a model FPC-5P which has a 5 level baudot paper tape punch/read assembly. I would like to interface this for computer or RTTY.

Robert G. Gilman
Box 103
Hellertown, PA 18055

Cassette Confusion

I have a problem with which I hope you, your staff or 80's readers could help me. I have a copy of the excellent tape Micro Music. Unfortunately, it is very annoying to have to pull the cassette plug out, plug it into a speaker, then plug it into the cassette player to load another piece of music.

Since I own an expansion interface, I know that you can have two cassette recorders attached, and if you store one in address 37E4H all I/O will be done on cassette two. This works great with Babybeep (80, April, 1980), but it will not work with Micro Music.

Since I know little Assembly Language I can't change this. I would like to be able to load the data on cassette one and play it out of cassette two. Can this be done? If so, I would like to know about it.

Also, if anyone knows how to put any Radio Shack machine language tape on disk, I would appreciate it if he would drop me a line.

Tarus P. Balog
Asheboro, NC

Morse Code Mod

My Morse Code program in your July 1980 issue is correct for TRS-80s without the Radio Shack E-Z cassette load modification. This modification is installed in all TRS-80s sold after early '79 and was made available for no-cost installation in mid '79 to all earlier models. If you have this modification installed, change the following eight lines to the Receive Mode section to read:

```
1290 IFA<200.....
1310 IFA>200.....
1330 IFA<200.....
1360 IFA>200.....
1380 IFA>200.....
1410 IFA>200.....
1430 IFA>200.....
1470 IFA>200.....
```

A special thank you to Gene Steele K5EVE, in Orangefield, Texas for this suggestion. It has been mailed out to all the 2000+ purchasers of the W4UCH TRS-80 Morse Program and should prove useful to your readers that have the E-Z cassette load modification installed.

Also, users should be reminded that a minimum of one volt peak-to-peak audio is required during receive without any RFI (radio frequency interference) going into the cassette input line from the station receiver, as the program obviously cannot discriminate between a valid Morse code signal and interference from the TRS-80. Good quality coax cable and a remote antenna at least 60 feet away from the TRS-80 is an absolute must.

Robert M. Richardson
Chautauqua, NY
Input to Page 40

slaving too long over a hot computer?



✓ 48

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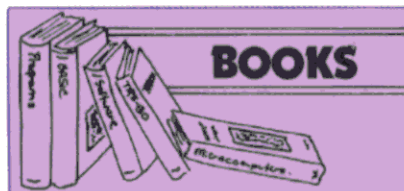
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80 REVIEWS

edited by Emily A. Gibbs

"He assumes the reader has a fairly good understanding of Level II BASIC, although all his tests... operate on a 4K machine."



TRS-80 Interfacing

Johnathan Titus

Blacksburg Continuing Education Series

Howard W. Sams & Co., Inc.

\$8.95

by Ed Neister

In *TRS-80 Interfacing*, Titus provides the reader with a practical knowledge of input/output circuitry and its operations. It is a basic book that should be in the library of all hardware designers who wish to work with the TRS-80 system for input/output control.

The book is written for a general reader. Titus does not go too deeply into the basics. He assumes the reader has a fairly good understanding of Level II BASIC, although all his tests and experiments are designed to operate on a Level II 4K machine with read/write memory and data storage capability.

Operation Control

Titus introduces the reader to the control signals one by one and helps the reader grasp the purpose for this control system and how to use it. He then goes into the operational control of these signals by using Level II instructions in computer programming steps. Titus leads the reader from the initial concept to a point where the reader can write the programs and generate the control signals he desires. Titus and the Blacksburg Group have developed a circuit which allows the reader to do all the experiments presented in the book.

Command of the Language

In the first chapter, Titus discusses the Z-80 microprocessor, its memory capability and the setup and use of the diode devices used through the Z-80 processor. The information is presented quickly and in great detail.

In Chapter one, Dr. Titus talks about the simple diode commands, as well as how software commands and interface circuits are used. He briefly discusses the PEEK and POKE commands in relation to interface circuits. He also goes over assembly language vs BASIC programming, as far as data transfer and control are concerned.

TRS-80 interfacing and its hardware are presented in more detail in Chapter two. Diode device addressing and decoding, as well as how gates are used for addressing and decoding are discussed.

Chapter three contains a detailed discussion of the output and input ports, device interfacing and memory mapping. Chapter four focuses on flags. The input/output device synchronization, logical operations, software detection of flags and complex circuit flags are considered.

Readers are introduced to the breadboard circuit design in Chapter five. This allows testing of the logic probe device, memory coder bus buffers and control circuitry. Next Titus considers circuit construction.

Interface Experiments

Chapter six is the central theme of the book and delves into detailed discussion of interface experiments. After an introduction, eighteen experiments are presented to help the reader test and understand the concepts of input/output transfer. The experiments reinforce the concepts presented throughout the book.

For the size of the book, much information is presented. Several appendices are given. One presents logic functions concerning lamp monitors, logic switches and pulses. Another gives the parts required for the experiments. The last three appendices give the Z-80 microprocessor, the TRS-80 interface breadboard parts and PC artwork, so that the reader can easily build his experimental circuit.

The first eleven experiments provide a set of interfacing and programming investigations for readers interested in interfacing concepts. The last seven experiments provide additional lab investigations of advanced topics and pro-

jects to supplement the experiments. They cover logic probe, device address decoding, device selecting pulses, constructing an input port, handling multi-byte input port information and input port applications, constructing an output port, I/O interactions, data logging and display.

An analog-to-digital converter is maneuvered by the computer in Experiment 11. When the program is run, the operator should be able to make the meter needle swing between two preset voltages.

Experiments 12 through 18 get more involved with device address and decoder circuits, output ports, BCD and binary coding, using the output ports and a simple program as a traffic light controller circuit.

Experiment 15 is an important one, used to demonstrate how logic device testing can be done. Simple flag circuits are handled in Experiment 16. Experiments 17 and 18 are more detailed in working with programmable interface chips and interfacing the A/D converter to the TRS-80.

Experiment 18 is very interesting from the standpoint that the resistance capacitance (RC) curve can be observed on the TRS-80. An RC curve is typically used to measure pressure, temperature, speed, conductance or many other physical perimeters.

The reader can obtain an overview of the subject in a quick reading. Next the breadboard circuit can be assembled, and the TRS-80 should be put to use.

The most dramatic thing about the book is that it gives the reader practical experience and guidance with the TRS-80 with program examples and actual hardware. When the reader has completed the book, he should have a good understanding of I/O devices and interfacing. ■

Computer Games for Businesses, Schools and Homes

J. Victor Nahigian and William S. Hodges

Winthrop Publishers, Inc.

Cambridge, MA

Softcover, 157 pages

\$10.95

by Len Gorney

Are you looking for a good computer games book that will give you a solid core of coding from which to develop your own personalized computer games? Do you welcome the challenge of converting a program from any version of BASIC to your own machine's BASIC?

Do you enjoy debugging others people's programs? Do you like to play computer games just for the fun of it? If you answer yes to any or all of the preceding questions, you are a prime candidate to purchase *Computer Games for Businesses, Schools and Homes*.

In his foreword, Mr. Weinberg introduces *Computer Games* as Winthrop's "first sally into new territory—the personal computer." The programs contained in this 157 page book are for the personal computerist. However, the particular version of BASIC, which runs on PDP type machines, used in these programs is not within the grasp of the average personal computerist. Assuming you don't have a DEC-type BASIC or DEC machine, there are a few changes you must make before you power up.

The backslash is used as the multiple statement per line delimiter in these programs. You will have to replace it with whatever character your BASIC uses as a separator, or code each statement on a separate line. You may have to change the PRINT statements to LPRINTs, if you want a printout. Using INPUT\$ or INPUT in place of GET and PUT statements will eliminate some problems in your INPUT and PRINT statements.

A listing of the variable names and their uses within the programs follows a short description and history of each game. This is a nice touch, especially if you are the type who likes to tear apart a program. A typical sample run and a program listing in an easy to read 5 x 7 dot matrix round out the games' introductions.

More Winners Than Losers

As with any collection, some of the games are losers. "Bullet" is the old—click, click—computerized version of Russian Roulette. "Poem" randomly generates one, but with little literary value.

"Psycho" is a minor league attempt to output your personality profile based on a design. Other poor selections include a Star Trek game, "Taplab" and "Tic-Tac-Toe."

What remains, however, are 21 winners that can be divided into five general categories: calculation games, casino games, dice games, grid/math games, and the ever present miscellaneous category.

One of the more interesting calculation games is called "Date" which, when given today's date and any other date, calculates the number of days between today's date and the second date. A variation of this same logic is used in the next two programs.

"Biorythm" is a graph of those critical days! "Compat" is advertised as a biorythmic compatibility calculation for two people. Interesting enough, for two people to be 100 percent compatible, they should either be born on the same day or their ages should differ by 59.86 years.

Casino games are the downfall of most personal computerists. *Computer Games* has "Blackjack", "Draw Poker" and "Jackpot", but done rather well. In addition to a fairly good description of each game, the authors have included probability tables which for "Blackjack", give the combinations and odds for hitting any particular count; for "Draw Poker", give the odds for being dealt each type of poker hand; and, for "Jackpot", a payoff table listing the odds for spinning a winner.

There are three interesting dice games, "Kismet", "Notone" and "Rollon"—if you go for the computer tossing dice, that is.

The grid/math/number games include "Boggle", a number-based Mastermind; "Escape", a grid game which pits you against five enemy attackers on a simulated battlefield; "Golf", a computer simulation; "Gunner", the old artillery game which teaches you a bit about trigonometry; "Skeedoodle", a math game; "Stock", a good stock market simulation.

Luck and Skill

The remaining four games require an equal amount of luck and skill. "Basket" is a

2-player basketball game. "Dogs" simulates a dog race for up to 13 bettors. This program even skims off 17 percent of the wager pool before it pays the win, place, show and perfecta wagers!

"Horse" pits up to 10 players, each having 12 horses. The object is to get one of your horses over the finish line before any of your opponents. "Tennis", anyone? Input your

position, the type of shot, and the area your shot should go to on the opponent's court and settle back.

The book is a good buy for anyone willing to accept the challenge of converting and debugging programs to expand his or her game library. It combines a learning experience with pleasure, and this, according to Weinberg, is the goal of *Computer Games*. ■

Planetary Lander
Instant Software, Inc.
Peterborough, N.H.
\$7.95

by John Warren

Space games are one of the most durable commodities of the microcomputer boom, and spaceship landing programs are a mainstay of the genre. One of the best of these is Planetary Lander by Instant Software, Inc.

While the early lander programs were limited to number displays, graphics are now in. Planetary Lander shows the position of your ship in relation to an altitude "yardstick," the scale of which changes as your ship approaches the planet's surface.

Next to the altitude display is a control readout that gives lapsed time, speed in meters per second, thrust and other indicators. Two of the readouts use horizontal bar graphs that give speed as a percent of terminal velocity and the amount of fuel remaining. These displays are updated at one second intervals.



Instead of limiting itself to a single planet, Planetary Lander allows the player to attempt a landing on any of the nine planets (and the moon) in the solar system.

Both the thrust and its duration are input as a single statement eliminating the need to repeatedly enter identical inputs—an annoying feature of some other lander games.

Although Planetary Lander is only available in Level I, Radio Shack's conversion program transforms it to Level II by altering only two PRINT AT statements (lines 300 and 330).

Combined with Stellar Wars, a space warfare game, in a two program package (Star Trek III), Planetary Lander is an outstanding value. ■

Interlude: The Ultimate Experience
Syntonic Software Corp.
Houston, TX
\$14.95 tape, \$17.95 disk

by Chris Brown
80 Staff

Silicon pundits have told us for a long time that computers will play a major role in our changing lives. We will see the advent of electronic mail, electronic money, even electronic crime. It seems to me that if the devilish device is ever to be mainlined into our cultural envelope, it must service more basic needs than game playing and accounts payable. Something really basic, for example, like sex.

The time has come. The era of home computer sex is finally at hand, brought to you by Syntonic Software, a forward-looking subsidiary of Software Technology, Inc. These people are not above pandering to your prurient instincts for a buck, or fifteen bucks, actually.

Billed as the ultimate experience, the Interlude package is a curious piece of software for several reasons, not the least of which is the unmitigated gall the folks at Syntonic were able to muster to market this X-rated program

in the first place.

What exactly is Interlude? Well, it isn't hard core, high resolution graphics, so if you're into blue movies, forget it. You won't get that sort of display with Interlude.

In essence, Interlude is a well-structured interview designed to plumb the depths of your sexual preferences in ten probing questions, after which it refers you to a book of "interludes" that accompanies the software.

The paper-bound, 96-page volume of interludes contains 106 elaborate sexual scenarios, written with acute attention to detail. Titles indicate content. For instance, "Wet Fun On A Hot Summer Night," "Good Vibrations," "Fellatio By Firelight," "Caveman," "My Way," "Satin Chains," "Macho Man." The list goes on.

If the computer-suggested interlude suits your fancy (or fantasy), you may opt to act out the scenario. In addition, certain interludes are stored in the computer and do not appear in the book. Getting one of these gems is apparently cause for self-congratulation. Your answers must have been outstanding!

This computerized extension of spin the bottle is not a revolutionary premise but is, one has to admit, an unusual application for the home computer and certainly not what the gang at Tandy had in mind.

The software algorithm of this machine lan-

guage program is straightforward. The interview format is logical, and all questions require a numerical answer, indicative of the degree of enthusiasm the respondent demonstrates. Some of the more mild examples are:

How complicated do you want this interlude to be?

1. Back to basics.
2. Keep it fairly simple.
3. I'm not choosy.
4. Maybe a small production.
5. I'm ready for a really big show!

—or—

If you were a movie, which would you be?

1. Pillow Talk
2. Tom Jones
3. Gone with the Wind
4. Superman
5. A Streetcar Named Desire
6. Fellini's Satyricon

After answering several of these thought-provoking questions, the computer gets down to the nitty-gritty and quizzes you on specifics, hopefully picking up on your mores, folkways and taboos. Your scalar answers are then processed, and an interlude indicative of your final tally is suggested.

The program is fairly interactive. Suzy, one of our foxiest secretaries here at *80 Micro*, displayed so little enthusiasm during one interview session that she was directed to interlude number 29. The scenario for this interlude instructed her to stay home alone and curl up with a good book.

If the interlude suggested is not quite what you had in mind (e.g., an acrophobic being assigned an interlude involving a high-flying swing), you may request an alternate interlude.

You may choose from about six alternates before the computer assumes you are a spoiled brat and gives up.

The disk-based version of Interlude we've been using even bombs out at this point, painting the screen with 2-byte stack symbols as the video memory fills. Although this seems like a bug to me, it does get the point across. Syntonic uses their own DOS boot, which may still contain a few bugs related to program termination.

For all its daring, the Interlude package is fairly tame in its attitude toward sexual encounters. The maximum number of participants in any interlude is limited to two, so no free-swinging, group gropes are possible. Furthermore, all interludes are strictly heterosexual. No gay or even bisexual interludes are allowed.

Syntonic hints that this is just the beginning. The last page of the book suggests that Interlude II is coming and requests that users send their favorite interlude to Syntonic for inclusion in the next edition. No mention of royalties is made, but the concept is certainly democratic. We may even feature the Interlude of the Month in *80 Microcomputing* someday.

Syntonic's marketing has caused raised eyebrows in the industry, and their full-page

living color ads have elicited both pro and con responses from readers. A few irate subscribers have taken offense at the quasi-naked lady approach Syntonic uses in their promotions and canceled. Generally, most readers seem curious or amused, rather than indignant. This may be just another indication of the decadence of the electronic age.

ISAM
Johnson Associates
Redding, CA
\$50.00

by William L. Colsher

I SAM (Index Sequential Access Method) is a set of BASIC subroutines and utilities that allow the programmer to create and maintain direct access files using keys, rather than the hardware-dependent numbers used by Radio Shack. For example, a program can access a library catalog by the title of a book, rather than by some arbitrary number. ISAM requires 32K and is available for the Model I or Model II.

The ISAM routines which must be merged into the application require about 4.5K. There are also minor restrictions on variable names used by ISAM and, of course, the line numbers used by the routines.

Efficient Disks

In return for these restrictions, ISAM pays off with greatly increased disk space efficiency. The Radio Shack random access file method wastes a large portion of space if your file has only a few records in it. If, for example, the file contains records numbered 1 and 100, you have actually grabbed space for 100 records, even though the file contains only two!

ISAM files with two records take up space for only two records.

In addition to BASIC subroutines, several utilities are provided on the distribution disk. INIT is used to create new ISAM files, REORG is used to free space taken up by deleted records and sorts the file in key sequence, and ISAM-PRNT enables you to list the entire file in key sequence on the printer or screen.

Most companies are content to simply provide the routines and utilities, but Johnson has included a demonstration program—a mailing list system. It may not be the most terrific mailing list program in the world, but it is more than adequate for my personal use and, I suspect, for some small businesses.

Suitability

ISAM does everything it promises very well. Anyone who has suffered the agony of trying to fit an existing numbering or naming system into Radio Shack's random access method, with everything but a shoehorn, should look into this package.

Finally, one of its best features is Johnson's delivery. I got my program six days from the day I mailed my check. ■

There you have it—Interlude: The Ultimate Experience. The first microcomputer-based adult computer program. Will it be a milestone in microcomputer software, or just another trendy diversion? Time will tell.

What's next? A microprocessor-controlled, RS-232-compatible love doll, perhaps. Welcome to the micro-millennia. ■

Z80ZAP/CMD
Org-Tex Industries
Lewisville, TX
\$29.95

by Bill Vick

Z80ZAP/CMD makes lost file recovery, file patches and file maintenance a real joy, primarily because of its Hash Index. Z80ZAP calculates the hash code for any file-spec instantly.

The Z80ZAP/CMD diskette comes with Backup on auto when it is booted up. This is a subtle way of telling the user to make a copy before he experiments with it. The diskette also contains a write protect tab, apparently one of those "protect us from ourselves" safeguards.

Automatic or Self-prompting

The documentation is contained in four brief, but comprehensive pages. Most of the commands are either automatic or self-prompting, making Z80ZAP a real breeze to use. Written in machine language, the run time is almost instantaneous in all modes, including power up.

When you load the program it waits two seconds for you to enter a command.

In the R (read) mode, having entered your drive, track and sector numbers, a well organized display appears on screen. The first column of numbers on the left side of the screen represents the drive number; the second column, the track number; and the third column, the sector you selected. Next is the column containing the byte numbers, or the location of the first byte of each row in the display. All columns are separated by a blank column for easy reading.

In the middle of the screen is a hex dump display of the sector you selected. To the right of the screen is an ASCII dump of the same sector. Each dump has its own flashing cursor. The cursors move relatively, indicating the ASCII byte that corresponds to the hex byte.

The most fascinating aspect of the program, the Hash Index Code, can be demonstrated while the display is on the screen. First, read a sector from the directory track, (11), sector 2-9. Choose a program listed in the directory and move the cursor down over the first letter of the filespec name.

By pressing H, a new column instantly appears on the screen between the hex and ASCII dumps. At the top of this column will be the Hash Code number for the filespec. Directly below it will be the words Hash Code spelled out vertically, with an arrow pointing to the

EXATRON STRINGY FLOPPY^{T.M.}

**SPEED
LOW COST
RELIABILITY**

Exatron is a California based corporation that has been in business since 1974. As well as the Stringy Floppy, Exatron designs, manufactures and sells state-of-the-art electro-mechanical equipment for a variety of commercial and industrial applications. Exatron is an established supplier of automatic test equipment to manufacturers, and large OEM users, of integrated circuits worldwide.

The software in every ESF adds a parity bit to every byte saved on tape, and a checksum to the end of every file. These are checked both after recording data and upon replay, any detected error is indicated by a message on the video display. This system of automatic error checking gives confidence in any data saved, also each wafer is rated for at least 2,000 complete passes past the record/replay head.

- ▶ Assembled and tested
- ▶ All operating software in ROM
- ▶ Fully automatic operation
- ▶ Professional quality
- ▶ No Expansion Interface required
- ▶ Large Owners Association
- ▶ High speed operation
- ▶ Extremely reliable
- ▶ No technical knowledge needed

WHAT IS IT?

The Exatron Stringy Floppy (ESF) is an extremely fast, reliable, economical alternative to cassette or floppy disk storage of computer programs or data.

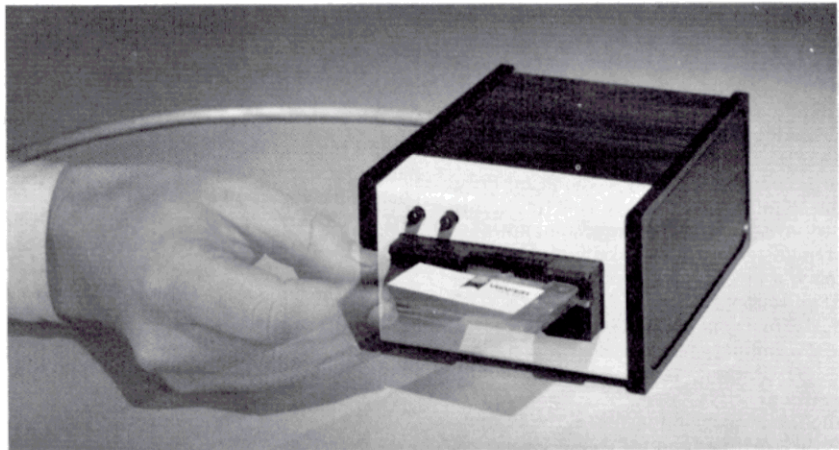
Totally self-contained, the ESF has no buttons, switches, knobs or levers to adjust or forget. All of ESF's operations are under the computer's control.

HOW DOES IT WORK?

The ESF uses a miniature tape cartridge (called a 'wafer') as the data storage medium, about the size of a business card and 3/16th of an inch thick. The tape used inside the wafer is a special Mylar based Chrome Dioxide type, specially developed for digital applications. Wafers are available in several lengths, 5 feet being the smallest and capable of holding up to 4 thousand bytes of information—the 75-foot wafer is the largest available and can hold up to 64 thousand bytes of data.

The wafers contain a single reel of the special tape connected as a continuous loop, the ends being spliced together with a piece of reflective tape. In operation the ESF drive unit pulls the tape from the center of the reel inside the wafer, causing the entire reel to rotate. Thus, the tape automatically winds itself around the outside of the reel at the same rate as which it is pulled from the center. This process is similar to that found in an 8-track cartridge.

The ESF transport mechanism is very simple, consisting of a precision die-cast aluminum block—with a capstan, drive motor and magnetic record/replay head mounted on it. The wafer loads into a slot in the casting (it will only fit the correct way) and the tape is driven at a single point by the capstan, past the record/replay head.



HOW DO YOU USE IT?

Once connected to your computer the ESF operating system needs to be activated—simple. Just type 'SYSTEM'(enter), and in response to the ? prompt type '12345' (enter). Your TRS-80 will instantly display the ESF sign on message 'EXATRON STRINGY FLOPPY VERSION 4.1', and from this point onwards you will have the extra commands '@LOAD', '@SAVE' and '@NEW' recognized by your TRS-80.

The ESF's operating system is built into the electronics of the unit, in much the same way that BASIC is built into the computer, so it is always available—the SYSTEM command is to let your computer know that the ESF has been connected. If you normally reserve some memory for subroutines then the ESF software will relocate itself under your selected top of memory. The ESF uses only 4 bytes of your available RAM, these bytes are used to 'point' to the 2048 bytes of software in the ESF unit itself.

WHAT'S THE CATCH?

Well, the only catch that most people find is that they have to actually pay Exatron for their unit! Even this is no big deal.

Starter Kits are available with the Exatron Stringy Floppy, a supply of wafers, a bus extender and a selection of useful programs—for \$299.50.

Through regular advertisements in both Kilobaud Microcomputing and 80 Microcomputing, owners are kept informed of the latest developments in wafer-based software. Plus hundreds of user 'workshops' are starting up over the country, so you can always be sure of being near to another ESF owner.

Exatron also gives a 30-day full money-back guarantee, with a 1 year parts and labor warranty on the unit.

If you have any questions about the ESF then give Exatron a call on the Hot Line (outside CA) 800-538-8559.

East Coast customers can call 800-343-4424 (inside MA 617-899-3862)

Open House Workshops take place from 9 am till 1 pm every Saturday at Exatron's factory in Santa Clara, and on the East Coast the last Saturday in each month at Micro Communications, 80 Bacon Street, Waltham MA 02154. All are welcome.

exatron

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Santa Clara, CA 95051
408-737-7111

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code at the top. Below this will be the track number, sector number and byte location to install the code to recover a killed file. By pressing the minus key you are able to page back to the first sector in the directory track, where you may apply the code to recover the file. The code, as well as all other information, remain on the screen as you page.

While in the display mode, pressing M, modify, allows you to change any byte in the display.

While in the modify mode, the hex cursor increases in size. Any key pressed (0-1, A-F) modifies the byte at the current location of the cursor. After each modification, the cursor advances one position.

While in the modify mode, you have access to the W, write, command. The W command does not immediately write to disk. Instead, the prompt comes up, asking you if you desire to write to a drive other than the one you read in. If the destination is the same, simply press ?ENTER? and the write takes place. You then return to the display mode.

Z80ZAP even makes sector compares easier by using the C key. Pressing C gives you a byte-for-byte comparison of any sector on any drive to the sector on the display. This function is nice to have, if a voltage spike or some other little gremlin got into your diskette. An example of this is a diskette that does not boot up because of a zapped byte in BOOT/SYS. The compare function compares this sector to a good diskette and pauses at each byte that is not the same. Pressing ?ENTER? continues the comparison.

Another invaluable function is the F, find, command. With a sector of data displayed on the screen, press F, followed by a two-digit hex byte. The flashing cursor goes off to look for the byte and resumes flashing directly over it—if it exists. If the sector does not contain the data, the cursor returns to the first location in the display. This function is great for apply patches or fixes.

Using the L, locate, function lets the program move the cursor for you. Press L, followed by the byte number you wish to pinpoint, and the cursor moves automatically over the location. This function also comes in handy in applying patches.

To escape any of Z80ZAP's modes, press X. This will return the flashing cursor to the first byte of the display.

Following are some of the other important functions of Z80ZAP:

- + or - Pages forward or backward, one sector at a time.
- Z Zeros out a sector, handy for cleaning up cluttered sectors on your diskettes.
- J Jumps to DOS READY. A word of caution here: After using Z80ZAP, always reboot the system, as the author resets the stack pointer to a different location than DOS does.
- D Puts you in debug: "G" [ENTER] returns you to Z80ZAP.

The documentation also includes easy instructions for removing passwords from all files, as well as extremely easy directions for recovering a killed file. ■



**Model 800 Printer
Base-2
Fullerton, CA
\$499**

by Milan D. Chepko

Shortly after adding a disk drive to my TRS-80, I decided it was time to turn it into a decent business system by adding a hard copy device.

I considered Radio Shack's price of over \$1000 for their line printer to be out of the question, so I started looking around in the computer journals. There are several companies producing less expensive line printers compatible with the TRS-80, but I finally settled on the Base-2 Model 800.

Among its many hardware and software features, perhaps the best is the low price—\$499 for the standard model with friction-feed paper drive.

The printer arrived about six weeks later than initially promised, and the paper rack arrived even later.

Lighter Than Centronics

Weighing 10 pounds and measuring 14 by 10 by 3 inches (six with tractors), the Base-2 printer is considerably smaller and lighter than the standard Centronics 779 printer from Radio Shack. It prints 60 lines per minute bidirectionally. Its ribbon cartridge is supposedly good for five million characters.

All the component subassemblies use connectors on the cables, so replacement should be relatively straightforward. The construction is generally sturdy and, though it should tolerate considerable use before needing repairs, I believe the Centronics 779 would stand up better under heavy day to day use.

The Base-2 printer uses an 8085 chip and two ROM chips, along with up to four RAM chips to achieve some sophisticated functions. For example, six different character densities are available per line (64, 72, 80, 96, 120, and 132), and can be selected by a back panel DIP switch or by a software control program.

The DIP switch on the back panel is used to establish a standard print density. This can be changed at any time. I generally leave mine in the 80 character position. This generates an automatic line feed after a carriage return, which is needed with the TRS-80.

In addition, the characters can be printed in double width in any of the densities, giving you 12 different type sizes. The double-width characters can start and stop in the middle of a line for highlighting. Also, lowercase characters can be printed by generating the proper ASCII code. (On the TRS-80, this is done by

holding down the shift key while typing the letters.)

The printer comes with two different sets of characters—standard and APL, both in ROM. There is room for three more character sets in ROM (although details are a little sketchy in the instruction book). A sixth set (maybe the TRS-80 graphics?) can be loaded into the on-board RAM by program software. Characters are printed in a 5 by 7 dot matrix.

Changing the different character sizes and fonts is relatively easy. Issue an escape character, followed by the control code describing the desired function. With the TRS-80, the sequence would be:

LPRINT CHR\$(27);CHR(X);

The codes are all described in the book that accompanies the printer.

Three options can be added to the standard Model 800. Option S controls the paper advance from one dot to more than full-character height. It permits rapid paper advance without forcing the print head to traverse the paper, which is important in printing graphics. Since this is a bidirectional printer, there is some variance in character position from line to line. Option S prints in one direction, which eliminates most of the wobble in the print-head-drive mechanism.

Option T is the tractor feed and I recommend it based on my limited experience with friction feed. Option M adds extra memory, enabling the printer to accept 1920 characters from the CPU in a burst, then print them out while the processor is doing something else.

Each of these options adds an extra \$50. But, in order to add the tractor feed (T), you have to add paper advance control (S). The tractor feed version ends up costing \$100 more than the standard model. However, this is still \$300 to \$400 less than the comparable Centronics model, which lacks many of the Model 800's features.

Versatile

Unlike many printers, this one is versatile with a capital V. In addition to the Centronics port required by the TRS-80, there is a serial port handling baud rates up to 19,200 and accepting RS232 or 20 mA current loop signals, along with an IEEE 488 port that should be compatible with Pet systems.

In general, the Base-2 printer is an excellent product, and should provide good service for most TRS-80 owners. As an added gift, it is quiet. Unlike the Centronics 779, the Base-2 printer is completely silent when it is not printing. If your printing workload is light to medium, the Model 800 could be just what you're looking for! ■

120 CHARACTERS/LINE
132 CHARACTERS/LINE
ELONGATED

Sample printout from the Model 800.

1. Outlasts every competitor—200,000,000 character head warranty
2. No duty cycle limitations—even in demanding business applications
3. Professional print quality—9 x 7 matrix
4. Rugged business use construction—metal chassis—two motors
5. 80 characters per second
6. Upper and lower case—full 96 character ASCII set
7. Double width characters
8. Connects directly to TRS-80™ APPLE® and other computers
9. Block graphics—64 shapes for charts, graphs, diagrams
10. Friction and pin feed
11. Plain paper—up to 3 parts
12. 6 and 8 lines per inch—program controlled paper savings
13. 80 and 132 columns—program controlled
14. Price—the best value in the industry. Call or write today for the name of your local Microline 80 dealer.



14 REASONS WHY TRS-80™ OWNERS CHOOSE THE MICROLINE 80

All fourteen are standard with every Microline 80. The only options are snap-on tractors and a buffered (up to 2000 characters) RS232 interface.

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80 ACCOUNTANT

by Michael Tannenbaum C.P.A.

"For the professional accountant or executive... (Visicalc) is a pure gift."

One of the most frequent questions that I have been asked is how the reliability of the Model II compares with the Model I. Until recently I was unable to give a reply. My Model II has performed virtually without a flaw since I acquired it. That is, until last week.

All of a sudden the program I was working on dropped out for no reason. When I attempted to reboot, the operating system gave me a memory fault error message. After several more tries, I gave up and brought the computer to my neighborhood computer center.

After a brief trial, the salesman agreed that the computer was not functioning properly and turned it over to the capable hands of the repairman. Twenty-four hours later it was returned properly repaired. Frankly, while I was not overjoyed to have the computer break down after it was out of warranty, the experience was not unpleasant. When the Model I had problems, the computer took so many trips to the repair center I thought they owned the machine.

Pioneered with Model I

Of course, to be fair, I was a pioneer with the Model I. Not only did I purchase one of the first 16K Model Is, but I also had one of the first interfaces and disk drives. When the machine broke down, the local repair center was unequipped to deal with it.

A major difference between the two computers lies in the diagnostics that the Model II automatically performs on power-up. This prevents you from using an improperly performing device.

Unfortunately, it is quite easy to use a sick Model I. Because much of its operating system is in ROM, a memory fault could remain undetected until a debugged program bombed. During the time the chip was inoperative, the owner could be quite unaware that the machine was causing problems. If the computer was just used for playing games, such a situation need not be fatal. However, if the Accounts Receivable or the General Ledger file was destroyed as a result of the flaw, recovery would certainly be painful.

I recommend that Model I owners acquire any of the diagnostic programs that are available and run them on a regular basis.

Well, now that we have covered the "unthinkable" system failure, let's get down to the subject of this month's column...Accounts Payable. Accounts Payable recordkeeping is a requirement for almost all businesses. Bills must be accumulated and paid for supplies, services and merchandise. Since this type of activity usually involves the analysis of invoices, cod-

ing for subsequent posting to the general ledger, posting to a vendor's payable ledger, preparation of a check and preparation of a remittance advice, much work is required. In fact, much of the data has to be written over and over again.

The tedious nature of this work has resulted in the development of many different Accounts Payable systems. One of the most common is the so-called One Write system. In a One Write system, a series of forms is designed so that the repetitious data is reproduced on all the documents by means of carbons with a single entry.

Another widely used method is the accounting machine, which, like the One Write system, uses special forms and requires careful positioning when posting data.

Recent models of electronic accounting machines are computers in almost every sense of the word. These electronic accounting machines, like their mechanical predecessors, maintain data on individual ledger cards, much like the generations of bookkeepers before them. Unfortunately, most computer systems do not generate a ledger-card type of record.

A ledger card contains not only the detail of open transactions, but also a record of histori-

cal closed transactions. Because a microcomputer does not have the capacity to retain closed transactions, a ledger card cannot be produced. If the lack of a ledger card makes it difficult for your staff to function, I'd advise against a microcomputer payable system.

At the end of last month's column, I indicated that the Radio Shack General Ledger system appeared to be the first element of a fully integrated accounting recordkeeping system. The Accounts Payable system catalogue #26-4505 is the second element. This system can stand alone or be used with the General Ledger. If it is to be integrated with the General Ledger, a second drive is required.

Prior to using the system, an initialization program must be completed. You are required to specify the firm's name, address, system password, internal ledger codes (GLCs) and accounting method to be used.

The GLCs are used by the payable system to identify ledger accounts. They are not compatible with the codes used in the General Ledger system. For example, an expense account requires two codes, one for Accounts Payable and one for the General Ledger. Both codes

continued to next page

EDUCATION 80

by Earl R. Savage

Education 80: The role the 80 plays in teaching/learning/educational experiences. This is the world of the classroom AND the homeowner learning to repair a leaky faucet; the driver learning to tune up his car; the new employee learning his job; the old employee learning new skills for a promotion.

Well, you have the idea. The young, old and in between are involved in teaching/learning/education at school, at home, work, play—everywhere. And the 80 can be the most effective aid to those learning situations if we can enlist its help.

That is exactly what we will be discussing in this space each month: using your 80 in all kinds of instructional situations. We will exchange ideas on planning, programming, evaluating and improving. We'll get into software, both home-grown and commercial, and even into hardware.

Sharing Techniques

In this column, we'll share thoughts and techniques for making the 80 a better teacher. That's right—*share*. We will discuss what I have found and the findings of others, including you. Each one of us knows something about the 80 and about a skill or process that others want to learn. Now is the time to begin to put it all together.

Me? Well, I've been in education and electronics more years than I care to admit. As far as the 80 is concerned, I am far enough "into" programming and computer assisted instruction (CAI) to have gained a bit of skill and glimpse its potential.

I am convinced that we are on the threshold of a real revolution in both formal and informal learning. The microcomputer will bring changes beyond our current imagining. Teach-

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80 ACCOUNTANT

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must be available to Accounts Payable, if automatic posting is desired. Failure to do this accurately will automatically abort the General Ledger update at the end of the month.

When using an integrated Payable and Gen-

eral Ledger system, it is a good practice to specify a Miscellaneous Account. In the event that the specific code is not known, the operator of the system will have an account to use which is acceptable to both the payable and ledger systems.

Looking over the sample reports supplied with the system, I was quite pleased to note many "big" system features. In addition to an Invoice Listing, Posting Report and an Aging Summary, there are Cash Requirements Reports, Check Preview Reports and a Discounts

Lost Report. Invoices are specified where a discount could be lost through failure to make a prompt payment. This feature, if properly utilized, can easily pay for the whole system.

The information package includes a sample check and an order form for supplies. I do not see any way to customize the check printout, so you will probably be forced to order a supply of window envelopes. Using this envelope eliminates the need for addressing envelopes to the vendor.

The screen formatting and the controls available to the user are quite advanced. I especially like the file maintenance screens. If you cannot remember the number of a vendor, you can search by name. If you type just a few letters, the computer will automatically put you into the proper range for retrieving the information. You can then use the "previous" or "next" options to locate the precise number.

The system has a capacity of up to 500 vendors and 3,000 unpaid invoices can be accommodated. As indicated previously it will run on a one drive Model II.

EDUCATION 80

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ing/learning will never be the same. We have barely scratched the surface.

All we have to do is apply our programming skills to create situations that help others learn most effectively.

You are invited—no, urged—to participate. I welcome your questions, comments and suggestions about this column. I and other readers will be most interested in your ideas, software techniques and hardware designs.

What have you found that works well? That doesn't work? The rest of us would like to know. Write me in care of 80 Microcomputing, and they will send you letter along. If you would rather "write" on a cassette, that's all right, too.

Oh, yes; I will answer as many of your letters as time permits, especially if you have included a self-addressed stamped envelope.

Recording Progress

Suppose that you have an instructional program that the user studies independently in school, office or wherever. Further, the "instructor" wants to keep a record of the user's progress.

Often in such cases, the user and/or the instructor simply writes down the final score from the display. It is much more satisfactory to have a printout of that information and that can be done with the simplest printer.

The following few statements will do the job on the little RS Quick Printer II. (Change the commands to suit your printer.)

```
1030 PRINT "PLEASE SWITCH ON THE PRINTER AND  
THEN PRESS ENTER."  
1035 BS=INKEY$: IF BS="" THEN 1035  
1040 LPRINT "NAME"  
1045 LPRINT "PROGRAM : AMATEUR THEATRE II"  
1050 LPRINT "SCORE : "R" RIGHT OF "T"  
ATTEMPTED"  
1055 FOR X=1 TO 4 : LPRINT : NEXT  
1060 END
```

Certainly, the variable names will have to be made to agree with those in the program. Everything should be clear, except perhaps line 1055, which simply runs the paper up four lines so that the printout clears the tearbar.

This small section prints the essential information, but is easily expanded to include what-

ever you want on the record. Best of all, not only can you put it in programs that you write, but it can be inserted easily into any you wrote and any that you've bought.

Program Modifications

A well known expression states, in one form or another, that one should not waste time re-inventing the wheel. So it is with programs. If there is an existing program that meets your needs, why spend time writing your own? Better to use it, while writing one that does not exist.

There are instances, however, when a program does part of what you want. It may be a game which uses the information you wish to teach. It may be an instructional program but written for the wrong level—too easy or too hard for the student(s). It may have too much or not enough explanatory material.

My own approach in these cases is to modify the existing program rather than begin at zero. Let's look at an example.

Suppose you want a tutorial program on Newton's Laws of Motion. Suppose, also, that you have one of the many forms of that popular game in which the player attempts to land a space vehicle on a planet. The game provides excellent application and practice in using Newton's Laws. Your best bet is to use that program and add the instructional part.

Here are some of the elements you would consider adding:

- Title introduction including personalization;
- Tutorial material, *per se*, on the level and to the depth appropriate;
- Introduction to and rules of the "game";
- Choice within limits of the number of times to play;
- Reward/reinforcement frames for success;
- Review frames for failure;
- Scoring and score-keeping;
- Summary review and conclusion.

As you see, even a game of the entertainment type can be turned into a valuable instructional program. There are many such possibilities. Often, too, relatively minor modifications will turn a poor program into an excellent one.

Don't re-invent the wheel. Get in there and apply it in a different way. In later columns we'll discuss the elements listed above and find ways to make them easy to add.

I'll meet you here next month for more Education 80. ■

Visicalc for Model I

Just before I completed this article, Radio Shack announced the availability of the Visicalc Software package for the Model I. This software package was originally developed for the Apple II and has proved so desirable that many Apples were sold on the strength of it.

For the professional accountant or executive who is responsible for planning and projections, this program is a pure gift. It turns the TRS-80 Model I into a multi-column, multi-line worksheet. Each column and line can be programmed so that a change in any one figure can automatically change all other related figures. For example, if you are budgeting a 12-month period, and each month's activity is related to a prior month, you can project an entire year's activity by simply entering the first month's data.

The program is designed so that the work area can be scanned either horizontally or vertically in columns one to sixty, or lines one to two-hundred-and-fifty-six. Any portion of the work area can be printed and the results of the calculations stored on the disk for recall at any time. I urge you to see a demonstration of this software. I'm sure you will be as enthused as I am.

In the several months that I have been preparing this column I have attempted to mix a little accounting theory with program reviews and recommendations. I am not sure how well this format has succeeded to date. I would certainly welcome any comment on how the column can be made more interesting. If you wish to contribute to the column, I will be glad to include your comments with the appropriate credits.

Since many of the TRS-80s currently being sold are disk systems, I am certain that there are many people who are using them for business purposes. Sharing experiences with others can be an excellent way to increase the value of the machine to all. I look forward to hearing from you. My address is: Michael Tannenbaum, CPA, 42 Bulaire Road, East Rockaway, NY 11518. ■

80 APPLICATIONS

by Dennis Kitsz

"As you may have discovered when trying to install the high-speed modifications, Radio Shack has made some changes."

The gentleman in the back. Yes, in the green shirt. What was that? Customize your TRS-80? Sure, folks, just a few simple do-it-yourself changes can turn your computer into a funny-looking, but more powerful machine. Step right up, heat that soldering iron. It's time for the Autumnal Equinox Hardware Festival!

This month we will be adding a second video jack, putting a radio frequency (RF) modulator into an expansion box, getting rid of the RESET lockup in the expansion box, bringing RESET up front, adding Level I and Level II, adding a keyboard expansion socket, eliminating the LPRINT/LLIST hangup, and doing some preliminary thinking about real-time clocks. And you can get nearly everything you need at your local Radio Shack.

In Preparation

First I have some mixed news for those of you with newer TRS-80s.

As you may have discovered when trying to install the high-speed modifications, Radio Shack has made some changes. The two-chip ROM set is slow, and takes up both available ROM sockets; the cassette load improvement modification ("XRX") prevents data I/O at high speed; and the new expansion box is somewhat locked into standard speed. Also, the updated no-bounce keyboard style makes it harder to install top-mounted items such as a control key, and so forth. Radio Shack has gone through so many alterations to the computer that models now hardly look like my own antique machine.

Let me offer a few precautions before starting. Open the case carefully, setting aside each part in order (six screws and six white keyboard grommets). Work on a large surface, and set the unit on a towel to protect its finish. Flex the keyboard's cable as little as possible, and put absolutely no stress on it. And most of all, always make any changes with the power off and disconnected.

Let's start with an easy one, the installation of an extra video jack. You'll need a sub-miniature plug/jack pair, a video jack, wire, solder and cosmetic tools.

You can always use this extra video jack, especially if your machine makes frequent appearances before the general public. You may add almost any sort of jack for which you have abundant matching connectors; I used a simple coax jack. Since long wires will tend to make your video signal look messy, choose a point near the normal video outlet to mount the new jack.

The plastic used for the TRS-80 case is soft and very pliable, almost enjoyable to work

with. Exact-o knives, drills, wood or linoleum cutting tools, and even screwdrivers can be used to cut the plastic to the right shape and smooth out a hole.

Open the case and select the placement of the jack carefully so that the 80 will reclose without striking or binding on the new hardware. Cut or drill a mounting hole, and install the video jack. Be sure to blow out the bits of plastic, because these chips, which will cling by static, can cause havoc underneath keycaps.

Now examine the TRS-80's normal video output (DIN) jack; it has five pins, three of which are used. Fig. 1 shows the video area with the cover removed.

You will need only two pins because the five-volt output pin is used for activating the optical isolation circuitry in the video monitor. Isolation is necessary because, unlike most commercial monitors, this one has "hot" parts unisolated from potentially dangerous AC power.

On Fig. 1, locate the video and ground traces (D and B) where the DIN jack connects to the circuit board. Obtain a miniature audio connector, and mount it on the board, soldering the center (hot) lug to point D, and the ground lug to point B.

Solder a short piece of coax cable to the mating connector, and run this to your new video jack. I used phono cartridge mounting hardware for this process. In any event, if ease of getting in and out of the TRS-80 is important to you, then mating connectors will allow you to work on the computer without having to

clip, solder, or disentangle anything.

Insert the connectors, snap the case together, hook up your second monitor, and power up. Ahhhh.

Picture and Sound, Will Travel

Do you carry your video monitor everywhere you go with your TRS-80? There's no need to do all that lugging. Using a simple RF modulator available in kit form, you can put computer power in your back pocket (if you have very big pockets). The materials you'll need are the modulator, a case, two five-pin DIN jacks, one DIN cable.

Start with the RF modulator—Radio Shack sells a \$15 Project Board and complete surplus units are easily found. Assemble it according to the directions. Hook it to an ordinary television, and temporarily run computer video (from the new output jack) to it. The picture quality will be underwhelming, but that is mostly a function of the limited bandwidth of commercial TV receivers.

For simplicity, you can put the whole assembly in a small equipment box, driving it with either your new video output jack or the built-in one. For the modulator's case, I used the empty slot reserved for the RS-232 board in the expansion interface, although any classy box will do.

The center pin of the video DIN jack (pin C in Fig. 1) in the TRS-80 is not used. To it, attach a wire from the cassette port's audio output line (pin G on the cassette connection shown in the

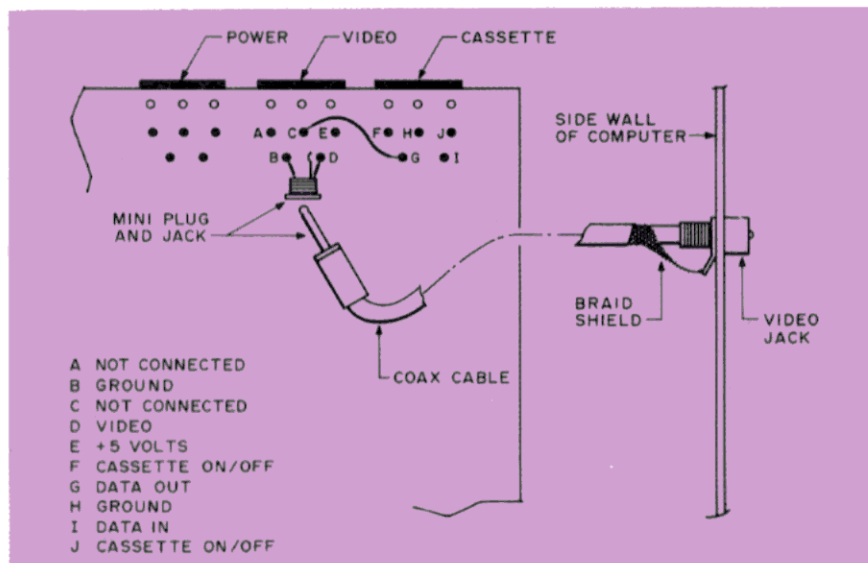
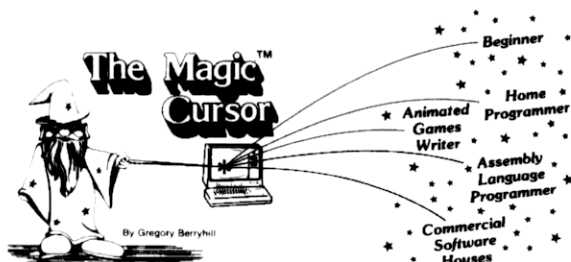


Fig. 1

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The Radio Shack catalog numbers, descriptions and prices for all the parts needed to compute the modification are shown below:

General stuff		
Wire-wrap wire	278-501-2,3	1.99
Solder-up	64-2090	1.49
Added video jack		
1 F-61 video connector	278-212	2/.89
1 Miniature plug/jack set	274-283	2/1.99
Added RF modulator		
2 5-pin DIN plugs	274-003	1.49
1 RF modulator (parts extra)	277-122	16.95
1 Case (optional)	270-232	2.49
1 DIN cable	42-2151	4.99
Modified E/I RESET		
1 Miniature SPST switch	275-612	1.69
1 10K ohm resistor	271-1335	5/.39
Added RESET button		
1 Pushbutton	275-1547	5/2.49
1 Miniature plug/jack set	274-283	2/1.99
Level I Addition		
1 Miniature DPDT switch	275-614	2.19
2 1K ohm resistors	271-1321	5/.39
1 Level I ROM set	(see text)	\$10 bribe
Keyboard addition		
2 16-pin wire-wrap sockets	276-1994	2/1.39
1 16-pin solder-tail socket	276-1998	2/.89
1 16-pin jumper cable	276-1976	3.99

Parts List

figure). Inside the RF box, wire two DIN jacks in parallel, hooking them up to the RF modulator as in Fig. 2.

A short DIN cable connects the computer to the RF box, the TRS-80's original monitor plugs into the box's other jack, and the RF output goes to an ordinary television. See Fig. 3. Picture and sound can now travel with me and my TRS-80.

Unlocking RESET

Speaking of the expansion box, I'm amazed that Radio Shack has let users suffer with a RESET button that locks up the computer when an E/I is connected. There's no good reason for leaving it that way, and fortunately the solution is very simple. You'll need a single-pole, single-throw switch and a 10K ohm resistor.

Open the expansion interface, and locate Z32 (near the power switch). If you have a newer expansion interface, this will be marked Z39. In either case the part is a 16-pin IC, type 74LS155. Now find pin 4, and identify the trace that leads underneath the IC and out its other side. Look carefully, using an ohmmeter to be sure it's the right trace.

Got it? Okay, take a sharp blade and cut through it. Run a 10K ohm resistor from the far side of the trace to pin 16 of Z32 (or Z39), and solder it carefully. Finally, run a pair of fine wires, one from each side of the cut trace. Solder one wire to each connection of the miniature toggle switch. When the switch is on, the cut trace is bridged, and the expansion interface acts normally. When the switch is off, the RESET button again works correctly.

Why did the expansion box hang up the computer in the first place? When you power up or hit the RESET button, the CPU clears a few internal items, and then sends out a signal to hex address 37EC, asking for information about the disk system. If it doesn't get anything (no

expansion box), it continues to READY (or MEMORY SIZE? at power up). But if it does find something (the disk chip in the expansion interface responding with the proper value), it sits and waits for the disk to start rolling and the data to come in. No disk... no data.

When we cut that single trace, we took the disk system's answer from the circuit. The disk controller is still sending a signal, but the computer doesn't see it. The CPU goes happily on to READY. As for the 10K ohm resistor, it acts like an electronic rope, restraining the answer circuit from triggering because of the high-speed electronic madness inside the expansion box.

Even disk owners will find this modification valuable, because it allows the disk drives to be disabled without flipping a glitch-inducing power switch. Also, readers using the LNW research expansion board may make the same modification. The IC is marked U19, but the rest of the process is identical.

An Easy-to-reach RESET

Where is your RESET button, anyway? In frustration, have you torn off the computer's little silver port cover? Maybe bent the cable and crashed the system when reaching for RESET? Well, then, bring the button up front!

Following the same carpentry precautions used for the extra video jack, install a momentary-on pushbutton (get them in packs of five from Radio Shack) at the left side of the computer. Just two wires are needed, as only half of the TRS-80 double-pole RESET button is actually connected in the circuit. See Fig. 4.

As before, it is wise to use some sort of mating disconnect plug so that access to the machine innards is simplified.

Don't put the button too close to the top of the keyboard, as many an Apple user has shed tears over hitting its badly positioned RESET button. Imagine being on the 7,000th word using Electric Pencil, and accidentally swatting RESET!

Level I BASIC on Level II

Your kids are having trouble with triple-dimensioning strings? They can't make sense out of ?DD ERROR and holler about having to type long lines of command words? Then why not use that nice and easy starting language—Level I BASIC?

But you just upgraded to Level II, you say! Fear not, for the virtues of both are available to you for the price of a switch and two resistors. Let's hope you've saved your Level I ROM... you paid for it the first time. If not, seek out a cooperative (\$10 usually encourages coopera-

@	A	B	C	D	E	F	G
H	I	J	K	L	M	N	O
P	Q	R	S	T	U	V	W
X	Y	Z					
0	1	2	3	4	5	6	7
8	9	:	:	:	—	:	/
ENT	CLR	BRK	UPAR	DNAR	LFAR	RTAR	SPACE
SHIFT							

Table 1

Column 1 — R8 — @ H P X 0 8 ENTER SHIFT
Column 2 — R5 — A I Q Y 1 9 CLEAR
Column 3 — R3 — B J R Z 2 : BREAK
Column 4 — R2 — C K S 3 ; UP-ARROW
Column 5 — R7 — D L T 4 , DOWN-ARROW
Column 6 — R1 — E M U 5 — LEFT-ARROW
Column 7 — R4 — F N V 6 . RIGHT-ARROW
Column 8 — R6 — G O W 7 / SPACE

Table 2

Row 1 — Z1 PIN 8 — @ A B C D E F G
Row 2 — Z1 PIN 2 — H I J K L M N O
Row 3 — Z1 PIN 10 — P Q R S T U V W
Row 4 — Z2 PIN 2 — X Y Z
Row 5 — Z1 PIN 6 — 0 1 2 3 4 5 6 7
Row 6 — Z1 PIN 4 — 8 9 : ; , — . /
Row 7 — Z1 PIN 12 — ENT CLR BRK UPAR DNAR
LFAR RTAR SPACE
Row 8 — Z2 PIN 4 — SHIFT

Table 3

tion) Radio Shack manager and obtain a Level I ROM set from the upgrade pile in the back room.

The ROMs you want are marked National, and are identified by the numbers M2316E/MMS258ET R/N and S/N, or Motorola, marked 7807 and 7804. Best of all is the single-chip Motorola ROM, marked 7809. You do not want chips marked Intel; these were very early ROMs, and wiring is complex.

Check to see if you've got a two or three-chip Level II ROM set. If you've got the three-chip set, there will be a connector cable running to a separate board. If not, both ROM sockets will be filled, and that means no room for Level I.

Handle the ROMs carefully (use special black foam or aluminum-foil-covered vegetable trays). Mount a double-pole, double-throw switch conveniently, but not where you are likely to flip it while using the computer.

Open up and turn over your TRS-80. The Level II interconnect cable will be plugged into one of the two sockets, and several additional wires will be connected from the Level II board to various parts of the main circuit card. Find the following locations:

- The green wire from the Level II board, connected near the underside of dip shunt Z3.
- ROM Socket Z33 or Z34 (whichever is empty), pins 18 and 20. See earlier "Applications" columns if you need to know how to read pin numbers.

Cut the traces leading from pins 18 and 20 of the unused ROM socket. Add a short length of

Enjoying 80 MICRO? then read on...

Okay, now you've had a chance to see what I have in mind for you with **80 MICROCOMPUTING**. Oh, I admit that we're just getting started and that the magazine will be improving a lot as we go along. We have some interesting ideas in the works for you.

With the TRS-80* (or 90... etc.) being the most popular microcomputer in the entire world, you are going to benefit from this in many ways. The more computers there are out there of one kind... the more good programs you are going to have for this system. I hope that is obvious. You may be sure that **80 MICROCOMPUTING** will be packed with the shorter programs and reviews of the larger ones. You can waste an awful lot of money on stuff that looks great in the ads, but fizzles out when you try to use it. You need our reviews.

The wealth of programs will also mean that there will be much better programs for the TRS-80* than any other system. Put yourself in the seat of a computer programmer and you'll understand this. If you are going to spend several months developing a comprehensive program, and it takes all of that to write and debug a big program, would you write it for a system which has sold one hundred units or one which has sold over 300,000 systems? The answer is obvious... and this is why we are already seeing programs coming out for the TRS-80* which are far better than anything for any other system on the market. This is tough for other systems... the law of the computer jungle.

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often from 50 to 100 a week! You'll get the cream of the crop either published or reviewed in **80**.

HARDWARE TOO

The same law of the computer jungle holds for hardware. Would you, as a manufacturer, market an accessory for a system which has sold 100 units or would you go first for the one which has sold hundreds of thousands. It is, as with software, self-evident why the great bulk of the hardware accessories for computers are for the TRS-80* these days.

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ENCYCLOPEDIA

If you've read Kilobaud MICROCOMPUTING, you know that I try hard not to duplicate published material. My concept is that every reader should save every issue (we sell inexpensive boxes for this so they can sit on your library shelf) and treat the magazine as a continuing encyclopedia of computing. I make sure that much of the material in each issue is written in simple language so it will be understandable by even the rawest newcomer to computers. Oh, I have articles for the more advanced users too, so you'll have something to look back over later and use as your understanding of your system grows.

Try to think of **80 MICROCOMPUTING** as more of a large club newsletter than an ivory tower high-level publication. I'll leave the pomp to other publishers... the ones with the well-deserved inferiority complexes who cater to their inadequacies by publishing esoteric baloney. This magazine is written by the readers and edited by people whose aim is to help you enjoy your TRS-80*.

SAVE

With each issue costing \$2.50 at your computer store, that's \$30 a year. For \$18 a year you can subscribe... at least for now. As the magazine expands, please do not be surprised if the cover price increases, along with the subscription price. I started **73 Magazine** for radio amateurs twenty years ago with a cover price of 37¢ (two for 73¢) and it is up to \$2.95 a copy now (and it is the largest of the ham magazines).

For you bargain hunters... and those who find that one year goes by all too rapidly, the three year rate for **80** is \$45. This, too, will be going up... reflecting the inflation, paper increases, postage increases, and a short vacation for me in Hong Kong next year. Someone has to pay for that.

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wire between pin 20 and the other end of the cut trace from pin 18. Solder a long white wire to pin 18.

Now remove the far end of the Level II ROM board's green wire from its connection point near shunt Z3, and solder a red wire in its place. A blue wire goes to the five-volt supply. I used Z57, pin 14. Run the other ends of the white, green, red and blue wires to the switch following Fig. 5.

Note also that two 1K ohm resistors are necessary to tie up the ROM chip-select leads when they are switched off. The resistors hold the chips inactive.

Now here comes the hard, or fun, part if you don't have the single-chip Level I set. Find the notch at the top of each ROM chip, and line up the two chips. Now *piggyback* one atop the other, and solder *all* 24 pin pairs, so that you've got a single, integrated circuit. Do it carefully, and be sure to keep the bottom IC anchored in some conducting material, like aluminum foil. The foil also acts as a heat sink, so work patiently and accurately; use good, fine solder, and always keep some Solder Up or Solder Wick handy in case a blob of solder fuses some neighboring pins together.

Insert this Level I hulk, or the single-chip ROM, in the empty socket. Snap the computer back together, and power up. You should either get MEMORY SIZE?, if it's switched to Level II, or a simple READY in Level I. You cannot switch back and forth; the languages get confused and "hang up." You must power up to the language you want.

Need a Second Keyboard?

It's an action game, and the youngsters are crowded about the keyboard. One youngster (balding, with grandchildren) complains, "Hey, I'm not close enough to the computer! It's rigged in his favor!"

Need another keyboard? No problem! You'll need two high quality wire-wrap integrated circuit sockets and one low quality solder-tail socket. All three are 16-pin types. You will also need some fine wire (wire-wrap is best), a 16-pin jumper cable, and a keyboard.

The type of keyboard is up to you. Perhaps you'll want a complete alphanumeric type (available in the \$40 range) or merely a \$10 numeric keypad. Whatever you choose, it should consist of individual keys, each with a single pole single throw (SPST) contact pair. Small calculator keyboards usually have matrix arrangements which aren't compatible with the TRS-80. Its keys are arranged in eight columns and eight rows, as shown in Table 1.

Depressed keys are identified in the TRS-80 software by column and row. Letter T, for example, is column five row three. That simplicity makes adding a keyboard a straightforward task, since no special encoding is needed. To identify any letter, you only need to know which column-row combinations produce it.

There is enough room on the far left side of the keyboard for a 16-pin socket in which to plug a jumper cable leading to the added keyboard. Inside the computer, this location is directly above a blank part of the keyboard's circuit card.

Use a flat screwdriver to snap out the black portion of the cover, and mark precisely where the free area is found on the baseboard. Using needlenose pliers, pull out all the pins from the solder-tail IC socket, and use the socket as a guide to mark the baseboard.

With a small hobby drill, make 16 holes in the board to match the 16 pins of the sockets. Slide one of the wire wrap sockets into the disemboweled solder-tail socket, using the latter as a special-purpose grommet. Feed the wire-wrap pins through the circuit board, and fasten the sockets in place with fast-drying glue.

Now remove the entire cover, turn the board over, and identify pin 1 of the socket. This will attach to column one. On most versions of the 80, you can use the keyboard's resistors to identify columns. See Table 2.

Match column one with socket pin 2. Match column two with pin 2, etc. Solder a wire to the resistors, and wire-wrap (or solder) the other end to the socket pins. Be sure to solder to the ends of the resistors closest to the keys. You will see that the other ends of the resistors are all tied together.

The keyboard rows are found at the input pins of specific IC's on board, but there have been so many versions of the 80 keyboard that this sequence is far from consistent. The technical manual (good for better than half the

machines in use, but not mine) identifies the rows as shown in Table 3.

It's better to check it yourself. Look for the traces connecting @, A, B, C, D, E, F, and G. That is row one. Solder a wire to some point in this row, and run it to pin 16 of the socket.

Locate row two, and solder to socket pin 15 and so forth down to row eight, soldering it to pin 9 of the socket. When viewed from the top, the arrangement will be as depicted in Fig. 6.

Once you have completed the wiring, clip the socket pins short, turn the board over, and place everything back in order. Leave the cover off, power up, and run through a few of the usual motions to make sure the computer is functioning properly.

Now take a short length of wire and, at the newly-installed socket, jumper each row across to each column. You should produce all the non-shifted keyboard characters, including the four arrows and the cursor.

Take a second length of wire and jumper row eight with column one. This simulates the shift key. Repeat the column-row test, and note that shifted characters appear. Any bizarre behavior, such as repeated letters, indicates that a wire may be shorted or attached to the wrong column or row.

Last of all, there are the cosmetics to deal with. Cut a rectangular hole the size of the

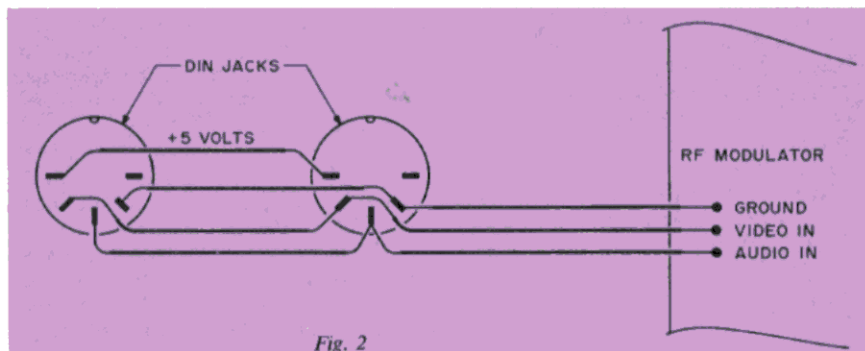


Fig. 2

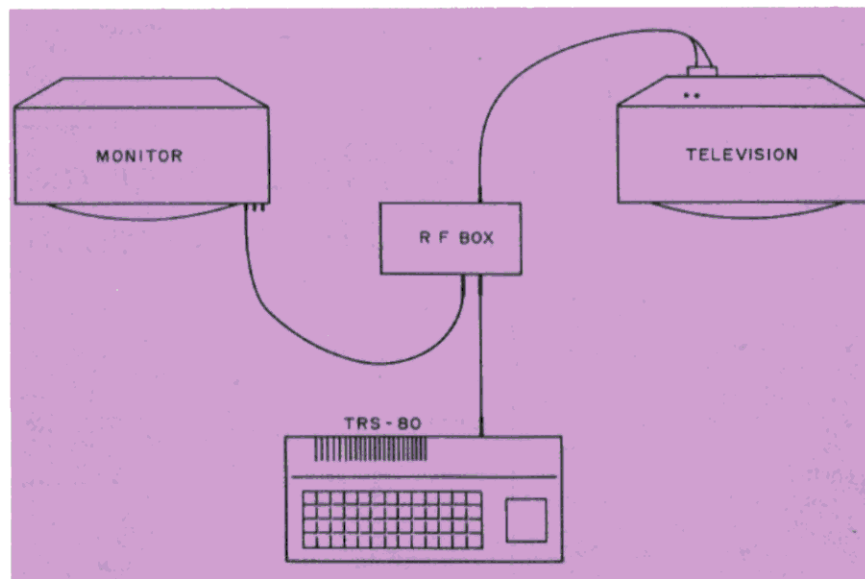


Fig. 3

16-pin socket in the black plastic cover using a hot, sharp knife or razor blade. Work slowly and carefully to achieve a factory finish (whatever that is).

Piggyback the remaining wire-wrap socket into the first one, and snap the cover back on. The socket should fit perfectly, rising about 1/16 of an inch above the surface of the cover. The cable plugs in at a comfortable distance from the keycaps.

For each keyboard you wish to add, work out a row-column key matrix to match the TRS-80's, using Table 1. You can either make the jumper cable an integral part of each added keyboard, or include a socket on it as well. Better yet, put a cable *and* socket on each extra keyboard, so that they can be chained.

No-printer Lockup

If you've got the time and patience, there's a good hardware fix to cure the LPRINT/LLIST no-printer lockup. It involves a few ICs, an edge connector, and lots of wire. Instead, do this:

POKE 16422, PEEK (16414) : POKE 16423, PEEK (16415)

Now do a few LPRINTs and LLISTs. See, it sends your mistaken Ls to the screen. Where's the hardware?

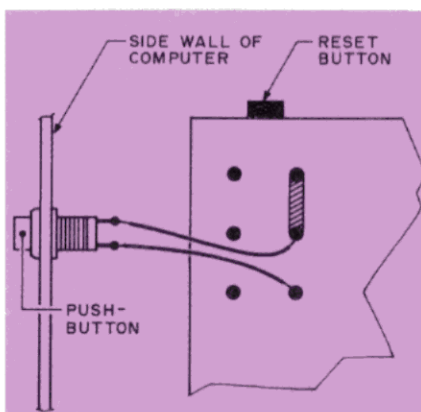


Fig. 4

The previous little item was included to make a point. With computers, there are many ways of achieving very similar goals. Software can run a printer without the mess of hardware used in the expansion box. Although a separate data generation circuit could have been used for cassette output, data is output via software instead. The whys and wherefores are rooted in economics, elegance and versatility. It was not too long ago that I built a nine-channel multi-media controller for a museum out of dozens of

discrete logic chips and transistors. A very simple CPU board and some software could have done 30 times that task. Time and technology make changes.

There are those computer users who, if they do not fear working with hardware, at least sneer at its apparent clumsiness. On the other hand, some folks cannot begin to understand the contortions (and labor-dollars) programmers go through to accomplish something in software that a 15¢ chip could do with ease. ■

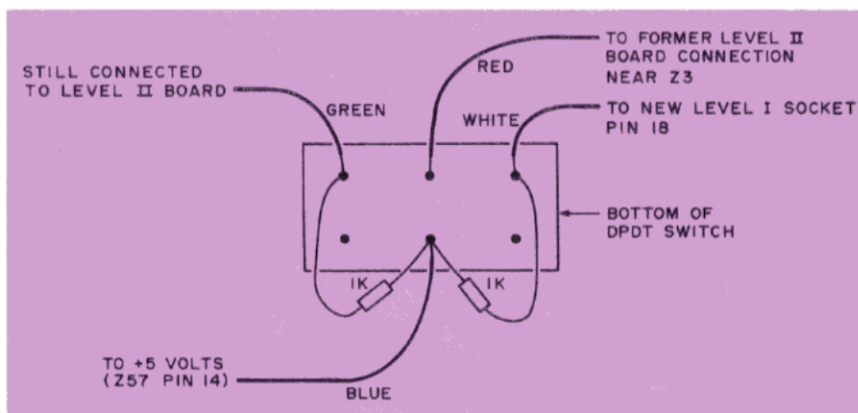


Fig. 5

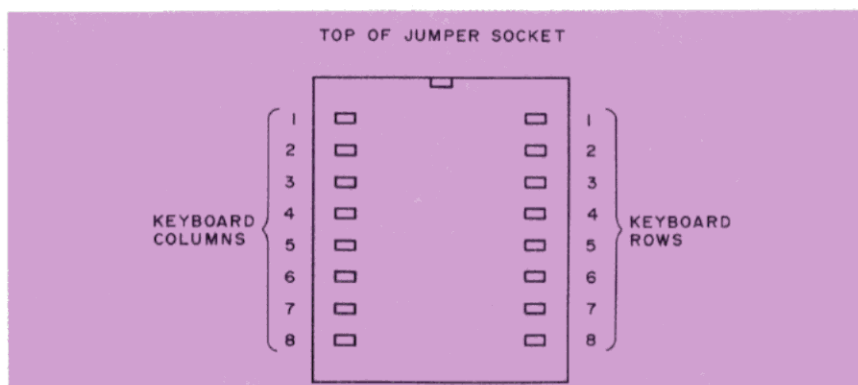


Fig. 6

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TLDIS & DLDIS

You've bought a super machine-code program, but now wonder how it works. Maybe you even used a quick PEEK routine to glance through it when it was in memory. If so, you definitely noticed the complete lack of comments in the code, making it almost impossible for you to decipher and understand it.

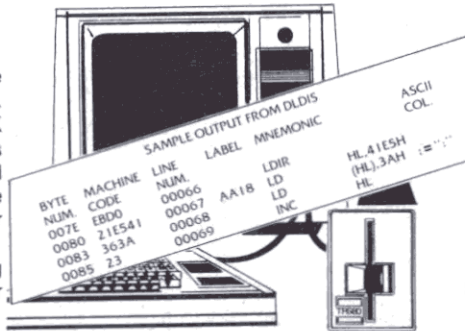
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You can send the disassembly to a lineprinter (Radio Shack parallel port) for either TLDIS or DLDIS. (The difference between these utilities is the storage mode of the disassembly.)

TLDIS can send the disassembly to cassette tape, DLDIS can send it to disk; both send it to the video monitor. The stored disassembly from TLDIS may be reassembled with Radio Shack's EDTASM(™)—the disassembly from DLDIS, with Apparat's extension of EDTASM(™).

Because of the use of labels, it is a simple matter to change any object code program by disassembling it and then



making changes to the resultant source code, without losing track of jump/load addresses. Labels start with "AA00" and increment up, in even numbered steps (AA02, AA04, etc.). The odd numbers (AA01, AA03, etc.) are left for you to use for the source code during reassembly.

The printing of the disassembly may be temporarily halted by using [SHIFT] @ (just as in BASIC) or it may be ended by pressing the [BREAK] key. It also has a comments column to display ASCII characters used in a LD or CP opcode.

Because TLDIS and DLDIS work only on in-memory programs, they may be relocated in memory to avoid conflict with the program you disassemble.

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This is a single-pass, hex-notation disassembler that will send its output either to tape or to a lineprinter (Radio Shack parallel port). The tape output is directly compatible with Tandy's EDTASM(™). Thus, you can take an object code tape, disassemble and output it to tape, then use EDTASM(™) to add, delete, change and even re-assemble your new version.

In addition, it displays the *displacement* and *absolute* address of any relative jumps made by the disassembled program. It also displays any ASCII characters used in a LD or CP opcode.

Sample output from the Disassembler

BYTE NUM.	MACHINE CODE	LINE NUM.	MNEMONIC	COMMENTS COLUMN
706E	22057B	00053	LD	(7B05H),HL
7071	183B	00054	JR	\$ + 3DH ;70AEH
7073	FE52	00055	CP	52H ;="R"
7075	2007	00056	JR	NZ,\$ + 09H ;707EH
7077	CD8F70	00057	CALL	708FH

H means the number is HEX

\$ means current location counter.

Since the Disassembler works only on in-memory programs, it has been made relocatable so that you may move it around in memory to avoid conflict with the program you wish to disassemble. As an added option, you may also jump to memory locations and transfer control between Disassembler and other utility programs in your computer.

The Disassembler, use it to examine and analyze any machine-code program!

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The Terminal-80 package lets your TRS-80 communicate with the rest of the world. These programs give you control of the RS-232 port of your Expansion Interface.

You can connect one or more serial terminals to your TRS-80. Your computer will accept input from the RS-232 port just as if it were entered from the keyboard. Thus, you can use your computer from a remote terminal without having to move your equipment.

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This package requires the following minimum system:

1. A TRS-80 with 16K of memory.
2. An Expansion Interface.
3. An RS-232 Serial Interface (e.g., Radio Shack's No. 26-1145 or the equivalent).
4. An optional upper/lowercase modification kit.

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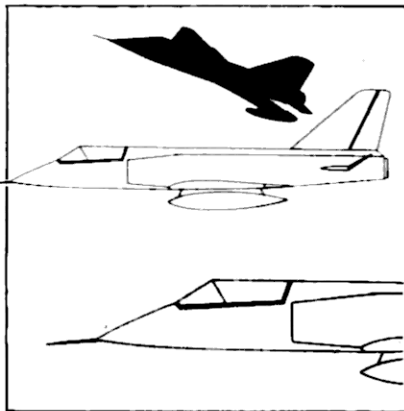
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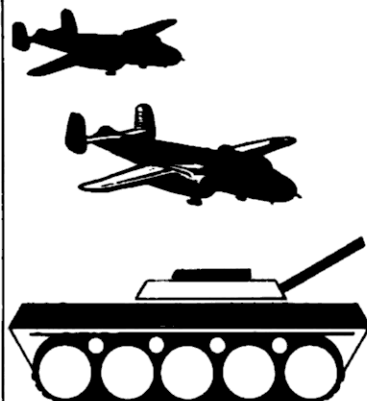
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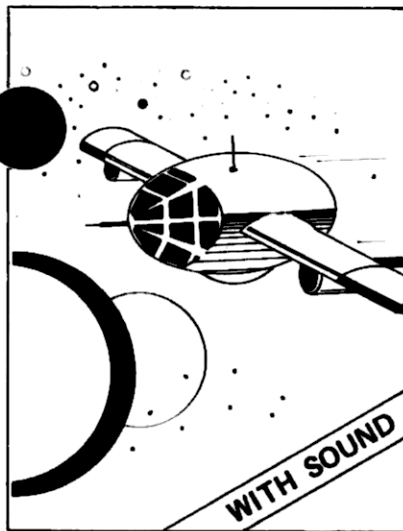
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THE ASSEMBLY LINE

by William Barden, Jr.

"Numeric computations are very tedious in assembly language, especially when floating-point numbers must be handled."

This month we're going to discuss interfacing assembly language code to BASIC—why it is desirable, what techniques are involved, and what kinds of problems will be encountered when it's done. We'll also be presenting the winner of the Great Second Assembly Line Programming Contest.

A Symbiotic Relationship

A program made up of both BASIC code and assembly language code takes advantage of both types of programming. BASIC can be used for all of the I/O bound processing, while assembly language can be used for the compute-bound processing, which must be as fast as possible.

An example of I/O bound processing is the portion of a mail list program that accepts user input for mail list entries. In this case, the high-speed processing of assembly language is unnecessary, as the data is being input at speeds no greater than 30 or 40 words per minute, and can easily be handled by BASIC code. A similar example is printing output, which proceeds at speeds in the area of 100 characters per second.

Assembly language code can be used in the compute bound, or "number crunching" portions of the program, where BASIC code is very slow. We've all seen or heard about mail list programs that take hours (or days) to sort entries. If the sort routines are coded in assembly language, this time critical portion of the program can be improved by a factor of 100 or so. Other examples of processing where assembly language can be used are high-speed graphics, searches, and array operations.

When one opts to use assembly language code, there are other trade-offs. BASIC code can be developed and debugged much faster than assembly language code. Numeric computations are very tedious in assembly language, especially when floating-point numbers (those larger than integer values) must be handled. String operations are not easily performed in assembly language.

However, in spite of its negative aspects pro-

grams of any significance can benefit greatly by having portions of the code in assembly language.

Level II BASIC and Disk BASIC allow BASIC code and assembly language code to be run together. The mechanism for this is the BASIC USR call. Let's illustrate the use of USR in Level II BASIC and Disk BASIC by some simple assembly language code. This code draws a line across the screen and is shown in Program Listing 1.

For reasons which we'll discuss later, the assembly language code here is relocatable. That is the machine code end result of the assembly (the hexadecimal data in the second column) can be moved anywhere in memory and will continue to draw that line on the screen. Non-relocatable code can only execute in one area in memory, the area for which it was assembled, controlled by the ORG pseudo-op in the assembly language statements. (For a more complete discussion of relocatability, see this column in the May, 1980 issue.)

Level II BASIC and Assembly Code USR Calls

Suppose that the 12 machine code bytes have been put into RAM memory at locations 8000H through 800BH. How do we execute the assembly language code at those locations while in the middle of a BASIC program? In Level II BASIC, the procedure is this:

1. POKE the address of the start of the machine language code into locations 16526 and 16527. The low order byte of the start address must be put into location 16526, and the high order byte must be put into location 16527. In this case 00H must be put into location 16526, and 80H must be put into location 16527. Locations 16526 and 16527 are simply a variable in BASIC that has been set aside specifically to hold the address of the machine code to be executed when a USR call is made.

2. At the point in the BASIC program at which you want to execute the "draw line" code, use the BASIC statement X=USR(M). When Level II BASIC encounters this state-

```
100 'LEVEL II CALL AND RETURN SEQUENCE
110 CLS 'CLEAR SCREEN
120 POKE 16526,0 'LS BYTE OF 8000H
130 POKE 16527,128 'MS BYTE OF 8000H
140 X=USR(0) 'CALL SUBROUTINE
150 GOTO 150 'LOOP HERE
```

Program Listing 2. Level II Machine-Language Calling Sequence.

ment, it takes the address value in locations 16526 and 16527 and calls that location. At the end of the machine language, a RET instruction pops the return address off the stack and causes a return to the BASIC interpreter, which picks up the BASIC code at the next statement after the USR call. This CALL and RETURN sequence is illustrated in Program Listing 2.

3. We've ignored variables X and M in the last two steps. If no arguments are to be passed, any dummy value can be used for M and variable X can be ignored. It's often necessary, however, to pass one or more arguments from the BASIC code to the machine language code and back again. For example, we might want to modify the assembly language routine to draw a line at any of the 16 screen lines, passing the line number of 1-16 from BASIC to the draw-line code. Conversely we might want to pass back to the result of a high-speed multiply routine to BASIC.

The USR call has a built-in provision for passing one argument to the machine code and for transferring one argument back from the machine code. The M in the statement X=USR(M) may be any variable or expression that resolves down to an integer value from -32768 to 32767. This argument is passed to the machine code in the HL register pair only if the assembly language code contains a CALL 0A7FH instruction. When the machine code executes the CALL, a ROM routine in Level II BASIC transfers the argument to HL.

To transfer an argument value of -32768 to 32767 back to BASIC, the value must be in HL and a JP made to ROM routine 0A9AH at the end of the machine language code; note that this "JP 0A9AH" replaces the normal RET.

Multiple Arguments and Multiple Routines

Multiple arguments may be passed from the BASIC code to the machine language code in a variety of ways. The arguments may be at some predefined location known to both the BASIC program and the machine language code, for example a list starting at location 9000H. A second way to pass arguments is to pass a pointer in HL; this pointer identifies the argument list, which has a predefined order. The pointer may

```
0000 0640 00100 ;ALL CODE HERE IS RELOCATABLE - NO ORG NEEDED
0002 21003E 00110 DRAWL LD B,64 ;64 CHARACTER POSITIONS
0005 3E8C 00120 LD HL,3C00H+512 ;START
0007 77 00130 LD A,8CH ;LINE
0008 23 00140 DRA010 LD (HL),A ;STORE SEGMENT
0009 10FC 00150 INC HL ;BUMP POINTER
000B C9 00160 DJNZ DRA010 ;GO IF NOT 64
000D 00170 RET ;RETURN TO BASIC
000E 00180 END
00000 TOTAL ERRORS
```

Program Listing 1. Line Drawing Program

```

00100 ;ALL CODE HERE IS RELOCATABLE - NO ORG NEEDED. THIS CODE
00110 ;ASSUMED TO BE AT 8000H.
0000 CD7F0A 00120 MULT2 CALL 0A7FH ;GET M INTO HL REGISTER
0003 29 00130 ADD HL,HL ;MULTIPLY BY 2
0004 C39A0A 00140 JP 0A9AH ;PASS BACK AS X
0000 00150 END
00000 TOTAL ERRORS

```

Listing 3A

```

200 'LEVEL II BASIC HERE. ASSUMES MACHINE LANGUAGE
210 'AT 8000H.
220 POKE 16526,0 'LS BYTE OF 8000H
230 POKE 16527,128 'MS BYTE OF 8000H
240 DEFINT M 'DEFINE M AS INTEGER
250 INPUT M 'INPUT INTEGER VALUE
260 X=USR(M) 'MULTIPLY BY 2
270 PRINT "X=";X 'PRINT RESULT
280 GOTO 250 'GO FOR NEXT
300 'DISK BASIC HERE. ASSUMES MACHINE LANGUAGE
310 'AT 8000H.
320 DEFINT M 'DEFINE M AS INTEGER
330 DEFUSR5=&H8000 'INPUT INTEGER VALUE
340 INPUT M 'MULTIPLY BY 2
350 X=USR5(M) 'PRINT RESULT
360 PRINT "X=";X 'GO FOR NEXT
370 GOTO 340

```

Listing 3B

be one established by the BASIC VARPTR command, and the pointer may point to an array or string containing multiple arguments. Another method is to pack arguments into HL. Four four-bit values could be put into HL, or one eight-bit argument could be in H and another in L.

More than one assembly language routine can be used with a Level II BASIC program; it's only necessary to put the starting address of the machine language routine to be called into 16526,7 before each new USR call is executed in BASIC. If there is only one machine language routine, its starting address needs to be placed into 16526, one time only, at the start of the BASIC program.

The calling sequence for Disk BASIC is somewhat more straightforward. Disk BASIC also uses the USR function, but it has a slightly different format. The format is X=USRn(M). The small letter n stands for any digit 0 through 9, which references one of ten possible machine code addresses. To call machine code routine 7, for example, the statement might be X=USR7(M). As in Level II BASIC, M may be used to pass one 16-bit argument, or it may be a dummy and X may be used to pass back one 16-bit argument, or it may be ignored.

Rather than POKEing the address of each machine language routine into 16526,7, Disk BASIC permits the addresses to be predefined by a new function, DEFUSRn. To define machine code routine 8 at 8000H, the statement DEFUSR8=&H8000 is executed sometime before the call X=USR8(M) is made. Everything else works as in Level II BASIC. CALL 0A7FH

is optionally made to pick up the M argument from BASIC, and a JP 0A9AH is optionally made to pass an argument in HL back to BASIC as variable X.

Another sample program with versions for both Level II BASIC and Disk BASIC is shown in Program Listing 3. This program takes one argument M from BASIC, multiplies it by two in the machine language code, and passes it

```

100 'DATA VALUES TO PREASSIGNED AREA METHOD
110 'MOVE DATA HERE
120 FOR X=32768 TO 32774
130 READ A
140 POKE X-65536,A
150 NEXT X
160 DATA 205,127,10,41,195,154,10
200 'LEVEL II BASIC HERE
210 POKE 16526,0
220 POKE 16527,128
230 DEFINT M
240 INPUT M
250 X=USR(M)
260 PRINT "X=";X
270 GOTO 240
300 'DISK BASIC HERE
310 DEFINT M
320 DEFUSR5=&H8000
330 INPUT M
340 X=USR5(M)
350 PRINT "X=";X
360 GOTO 330

```

Program Listing 4. DATA Values to Preassigned Area Example.

back to BASIC as variable X. It illustrates all of the concepts we've been talking about except for multiple argument passing.

There are basically two methods for interfacing machine language programs to BASIC programs. The first is the two program approach. The second is the embedded machine language approach. We'll discuss the techniques and advantages of each.

The Two Program Method

In the two program approach, the BASIC program contains no machine language code. The machine language code is separately assembled and loaded. To integrate the BASIC program and the associated assembly language program for a cassette based system, the following steps are performed:

1. Execute Level II BASIC. For MEMORY SIZE?, type in a memory address corresponding to the start of the assembly language program. Normally this would be in high memory, as everything above this address will not be used by the Level II BASIC interpreter.

```

100 'DUMMY STRING USING CHR$
110 A$=CHR$(205)+CHR$(127)+CHR$(10)+CHR$(41)+CHR$(195)+
CHR$(154)+CHR$(10)
200 'LEVEL II BASIC HERE
210 DEFINT M
220 B=VARPTR(A$)
230 POKE 16526,PEEK(B+1)
240 POKE 16527,PEEK(B+2)
250 INPUT M
260 X=USR(M)
270 PRINT "X=";X
280 GOTO 220
300 'DISK BASIC HERE
310 DEFINT M
320 B=PEEK(VARPTR(A$)+1)+PEEK(VARPTR(A$)+2)*256
330 IF B>32767 THEN DEFUSR5=B-65536 ELSE DEFUSR5=B
340 INPUT M
350 X=USR5(M)
360 PRINT "X=";X
370 GOTO 320

```

Program Listing 5. Dummy String Using CHR\$ Example.


```

100 'DATA VALUE TO DUMMY STRING
110 A$="DUMMY S"
120 B=PEEK(VARPTR(A$)+1)+PEEK(VARPTR(A$)+2)*256
130 IF B>32767 THEN B=B-65536
140 IF B>32767 THEN C=B+6-65536 ELSE C=B+6
145 IF B>32767 THEN D=-1 ELSE D=1
150 FOR X=B TO C STEP D
160 READ A
170 POKE X,A
180 NEXT X
190 DATA 205,127,10,41,195,154,10
200 'LEVEL II BASIC HERE
210 DEFINT M
220 B=VARPTR(A$)
230 POKE 16526,PEEK(B+1)
240 POKE 16527,PEEK(B+2)
250 INPUT M
260 X=USR(M)
270 PRINT "X=";X
280 GOTO 250
300 'DISK BASIC HERE
310 DEFINT M
320 B=PEEK(VARPTR(A$)+1)+PEEK(VARPTR(A$)+2)*256
330 IF B>32767 THEN DEFUSR5=B-65536 ELSE DEFUSR5=B
340 INPUT M
350 X=USR5(M)
360 PRINT "X=";X
370 GOTO 340

```

Program Listing 6. DATA Value to Dummy String Example.

```

100 'DATA VALUE TO ARRAY
110 DIM A%(6)
120 FOR X=0 TO 3
130 READ B,C
135 A=B+C*256
140 IF A>32767 THEN A%(X)=A-65536 ELSE A%(X)=A
150 NEXT X
160 DATA 205,127,10,41,195,154,10,-1
200 'LEVEL II BASIC HERE
210 DEFINT M
220 B=VARPTR(A%(0))
230 POKE 16526,B-INT(B/256)*256
240 POKE 16527,INT(B/256)
250 INPUT M
260 X=USR(M)
270 PRINT "X=";X
280 GOTO 250
300 'DISK BASIC HERE
310 DEFINT M
320 B=VARPTR(A%(0))
330 IF B>32767 THEN DEFUSR5=B-65536 ELSE DEFUSR5=B
340 INPUT M
350 X=USR5(M)
360 PRINT "X=";X
370 GOTO 340

```

Program Listing 7. DATA Value to Array Example.

2. Use the SYSTEM command to load a previously assembled machine language program into the protected memory area. Rather than typing slash to start executing the machine language code, hit BREAK to go back to the BASIC interpreter.

3. Execute the BASIC program with its USR calls to the machine language code. The ma-

chine language code loaded by the SYSTEM tape may contain many different routines, each of which can be specified by the proper POKE commands to 16526,7 and a subsequent USR call.

To utilize the two program approach with a disk based system, follow these steps:

1. LOAD the machine language program in-

to memory. The program must have been previously assembled with an object file to disk (Apparat assembler) or have been previously loaded and saved on disk (Radio Shack Macro Disk Assembler).

2. Execute Disk BASIC by the usual BASIC input. Protect the machine language code by entering the starting address of the machine language code for "MEMORY SIZE".

3. Execute the BASIC program with its DEFUSRn and USRn functions.

This method works well, but is best used for lengthy assembly language programs that cannot use the procedures for embedded code that we'll outline shortly. Since it is a two step loading process, it is somewhat awkward to use. Its main disadvantage is that the BASIC code must deal with absolute addresses; if the assembly language portion is reassembled, the addresses of its routines may change, and the corresponding addresses in the BASIC program will also have to be changed.

The second method of interfacing is the embedded machine code approach. This approach is best used when the machine code consists of short routines. The data representing the machine code instructions can be incorporated into the BASIC program directly, as DATA values, CHR\$ strings, or dummy strings. The advantage of this approach is that the BASIC program, complete with its embedded machine code, can be loaded or edited in one fell swoop.

The disadvantage is that some conversion is involved, to change the machine code from an assembly listing to corresponding decimal DATA or string values. There are a number of ways to embed the machine code; we'll discuss the most popular.

DATA Values to Preassigned Area

This is similar to the two program method in that the machine code is at a predefined area and should be protected by a MEMORY SIZE value. In this approach, the machine code in a DATA table is moved to its area sometime prior to the USR call. Since the area is predefined, the machine code does not have to be relocatable, but simply assembled to run at the specified memory area. An example for both types of BASIC is shown in Program Listing 4.

A dummy string consisting of CHR\$ values can also hold the machine code. The location of the string is found by the VARPTR function. As one reader pointed out, this approach has a potential problem. When the infamous "string garbage collection" mode is entered in BASIC, the location of strings may change. The garbage collection mode is entered when all string space has been used, and the interpreter must go back and clean up the string allocation area to create additional room. (Garbage collection is used in lengthy BASIC programs that manipulate many strings.)

When using this method, find the VARPTR location immediately prior to the USR call; it will work without problems except a 255-byte limitation on string size. Relocatable code must be used. This approach is shown in Program Listing 5.

DATA Value to Dummy String

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8000 58      00110 ;FAST MULTIPLY BY STEVE NELICK, WASHINGTON, DC.
8001 1600     00120 MUL      LD      E,B
8003 62      00130      LD      D,0
8004 6A      00140      LD      H,D
8005 07      00150      LD      L,D
8006 3001     00160      RLCA      ;ROTATE M'IER BIT TO CY
8007 19      00170      JR      NC,$+3
8008 19      00180      ADD      HL,DE
8009 29      00190      ADD      HL,HL
800A 07      00200      RLCA      ;ADD M'CAND TO TOTAL
800B 3001     00210      JR      NC,$+3
800C 19      00220      ADD      HL,DE
800D 29      00230      ADD      HL,HL
800E 07      00240      RLCA      ;SHIFT M'IER BIT
800F 19      00250      JR      NC,$+3
8010 3001     00260      ADD      HL,DE
8011 19      00270      ADD      HL,HL
8012 29      00280      RLCA      ;GO IF M'IER BIT = 0
8013 07      00290      JR      NC,$+3
8014 19      00300      ADD      HL,DE
8015 3001     00310      ADD      HL,HL
8016 19      00320      RLCA      ;ADD M'CAND TO TOTAL
8017 29      00330      JR      NC,$+3
8018 07      00340      ADD      HL,DE
8019 07      00350      RLCA
801A 3001     00360      JR      NC,$+3
801B 19      00370      ADD      HL,DE
801C 29      00380      ADD      HL,HL
801D 07      00390      RLCA
801E 07      00400      JR      NC,$+3
801F 3001     00410      ADD      HL,DE
8020 19      00420      ADD      HL,HL
8021 29      00430      RLCA
8022 07      00440      JR      NC,$+3
8023 07      00450      RET      NC
8024 3001     00460      ADD      HL,DE
8025 19      00470      RET
8026 29      00480      END
8000 TOTAL ERRORS

```

Program Listing 8. Fast Multiply Winner.

This approach avoids the garbage collection problem by moving DATA values to a dummy string made up initially by legitimate string values. The location of this type of string is always within the statement itself, rather than being in the separate string area. (You may want to verify this by some experimentation with the VARPTR.) The size of the string must be at least equal to the number of machine code bytes to be stored. The 255 byte maximum size limitation remains. Relocatable code must be used. This approach is shown in Program Listing 6.

DATA Value to Array

A final method was suggested by Charley Butler of the Alternate Source. In this case, the DATA values are moved to an array. As arrays are allocated once and are not reshuffled, there is no garbage collection problem. Also, the arrays may be as large as is necessary, and any size machine language program may be used. Relocatable code must be used as the array location is not known beforehand. This approach is shown Program Listing 7.

The Great Second Assembly Line Programming Contest

There was an excellent response to the second contest problem posed in this column in June: Write the fastest subroutine possible to multiply two eight-bit unsigned numbers in the A and B registers with the result to appear in HL with A and B preserved.

Entries were in four categories; those that used huge tables to precompute the result, those that used repetitive addition (too slow), those that used standard eight-iteration loops

(some very elegant), and those that wrote inline code to repeat the computations eight times, avoiding the loop overhead.

As the decision of this blear-eyed judge is final, the winner belongs in the last group, having the fastest worst-case multiply that did not use extensive pre-computed tables in memory. He is Steve Nelick of Washington, DC and his fast 157.85 microsecond multiply is shown in Program Listing 8. He will shortly receive a copy of the new computer science bestseller *Godel, Escher, Bach* by Hofstadter and a copy of my new Radio Shack fiction book *Programming Techniques for Level II BASIC*.

Honorable mention goes to Foulk, Van Pelt, Mignery, Wallen, Lee, Craig, Thomas, and Smith.

I appreciate all of the entries. Some of you went to elaborate documentation and I am in awe of the amount of work you performed.

Many have asked me to keep the problems coming, so I am duty bound to pose a third problem: Write an assembly language subroutine to draw a line between any two screen character positions. (Not points! There are 16 lines of 64 character positions.) There will be two winners, one for the most elegant version, and one for the fastest version. Again, token prizes will be awarded. Send entries to the address at the end of this column.

Next month we'll discuss the mysteries of the Radio Shack Disk Assembler and review some assemblers for the Model II. ■

William Barden, Jr.
28182 Palmada
Mission Viejo, CA 92692

80 INPUTS

from page 16

Double Size Graphics

In Bertram Thiel's article, "Double Size Graphics" which (June 80), states that the only way to escape the double character mode is with a CLS, or as he goes on to describe later, a series of PEEKs. Actually, he is in error, the TRS-80 provides an escape from this mode via the CHR\$(28), which returns the cursor to home, and resets the screen back to 64 characters. It is the exact opposite of CHR\$(23) and can be used as such.

Jeff Eisen
Huntington Valley, PA

Super Program

I would like to commend Delmer Hinrichs for his super BASIC Word Processor program that appeared in the May issue of *80 Microcomputing*.

The program runs perfectly with just minor changes to accommodate my printer and provide for a stop between printed pages so that single sheets can be used. The changes I made are:

1. Use LPRINT" " at the end of line 1690
2. Add line 1675 to provide top margin of one inch on single sheets and paper advance on rolled paper.
1675 FORZ1=ITO6:LPRINT CHR\$(138):NEXTZ1
3. Delete LPRINT CHR\$(28) and GOTO1680 from line 1740
4. Add new line 1745:
1745 INPUT"NEW PAGE--PRESS ENTER WHEN READY";Z1:GOTO1675

There is one apparent misprint in line 880 (a lowercase 'P'). I'm guessing, but I think that the misprint should be replaced with a zero.

Morris L. Krome
Owings Mills, MD

Recorder Variation

For the past three years Grant Union High School in Sacramento California has been developing a TRS-80 based microcomputer program as part of our math and science curriculum. During this period we have continued to acquire systems and build an extensive library of programs on tape and disk. Many of our programs were CSAVED on the CTR-41 recorder. Most of our recorders are now CTR-80s.

We developed an equation to convert reference numbers from one tape recorder to another. We checked our results on several different tape recorders and found the maximum variation to be one to two percent.

The equation relating the two systems is as follows:

$$\begin{aligned} \text{CTR-41}(\#) &= (1.66)(\text{CTR-80}(\#)) \\ \text{CTR-80}(\#) &= (.6)(\text{CTR-41}(\#)) \end{aligned}$$

Madeleine Fish (Teacher)
Steven Emert (Student)
Sacramento, CA

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✓ 33

"The two existing and complex sets of standards have led to classification chaos of the buyer."

COBOL on the 80: Prospects & Pitfalls

If the item about Tandy's new COBOL (Common Business Oriented Language) compiler didn't catch your attention in "80 News" last month, take another look. And take a peek at June's issue where you'll find the Nevada COBOL compiler. Then there's May with Microsoft's COBOL announcement.

Chairman of the American National Standards Institute (ANSI) COBOL Committee James Panttaja explains that the introduction of COBOL for microcomputers "may put micros in a different market place, taking them beyond the home, where they started their existence, into the business world."

One of the first things anybody hears about COBOL is that there are hundreds of thousands of business programs written in the language and hundreds of thousands of programmers trained in COBOL. Like Panttaja, many people believe that the TRS-80 compilers, which convert COBOL to machine code, will open the door for 80 owners to the wealth of tried and true COBOL business programs.

COBOL was first introduced to the market in 1959—about one and a half decades before the advent of microcomputers. The language was designed to be self-documenting. It is written in full English words, in statements and paragraph-like formation. The idea was that a group of people could develop programs jointly, with each program continually stating its objectives and progress in plain English.

Although COBOL originated from an effort to organize national libraries, Microsoft's Mike Orr explains that, "Over the years, COBOL has been tuned to be just what people want it to be." It began with good text movement capabilities and now exceeds BASIC and word processors in screen formatting, generating rows and columns of data, report generation, Indexed Sequential Access Method (ISAM) filing and graphs.

But because of its vocabulary and syntax, COBOL is a bulky language that can take up a great deal of memory. And it is a slow process to develop COBOL programs. Programming in BASIC is both faster and easier. Yet, BASIC cannot be applied to business applications as thoroughly.

The situation is not simple. In its short history, BASIC has already been written in many versions. There are BASICs for every level of the TRS-80, the Apple and the Pet. There are BASICs for disk operating systems

and others for cassette systems. In the long history of COBOL, it is hard to say how many versions of the language exist. Because of these differences in COBOL, programs will need to be translated, not only from machine to machine, but from one version of COBOL to another, to operate on the 80.

Languages dubbed COBOL range from scant, specific application languages to gargantuan languages that can operate in 12 modules serving countless applications. The price range of the three COBOLs with compilers that have been listed in "80 News" is indicative: Business Microproducts' Nevada COBOL for TRS-80 Models I and II with CP/M costs \$99. Tandy's TRSDOS COBOL for the Model II costs \$299. Microsoft's TRSDOS COBOL-80 compiler costs \$750.

"Programs will need to be translated, not only from machine to machine, but from one... COBOL to another."

In an effort to limit the confusion caused by the proliferation of COBOLs, ANSI established the first COBOL standards in 1968. They were updated in 1974, and a corollary set, the Federal Information Processing Standards (FIPS), was issued in 1978.

Deciphering COBOL types and standards is undoubtedly more difficult than programming in COBOL. The importance of this standards maze is its impact on the translation of the thousands of COBOL business programs already in existence.

The ANSI-74 standards divide COBOL into 12 possible modules and require only sufficient performance in the first three to classify a language as COBOL. These three modules are termed Nucleus, Table Handling and Sequential I/O. The complete ANSI standards are explained in the ANSI X3.23 manual. The 1978 FIPS standards separate COBOL into four

classes: low; low intermediate; intermediate, and high.

ANSI's Panttaja asserts, "If the levels of FIPS or the modules of ANSI-74 are the same, very little rewrite is necessary to write a comprehensive and comprehensible translation from any machine to another." Without the standards, COBOL translation can be just as difficult as any other machine translation.

The two existing and complex sets of standards have led to classification chaos for the buyer. Further, any distributor of COBOL will be quick to tell you that the standards do not account for non-standard extensions of their language. There are also factors of speed and run time programs to be considered.

When and if you get the standards sorted out, there's still a hitch. As Panttaja explains, "There's no means of verifying ANSI standards." And although the government, through FIPS, has devised tests to validate COBOL language compilers, they are administered by manufacturers. There is no government grading or verification of the test results.

New ANSI standards are being developed now and are expected to be released in the next few years. The *COBOL Information Bulletin*, citing what can be expected of the future standards, is available from the ANSI COBOL Committee, 1430 Broadway, New York, NY 10018.

Despite the lack of software, both Microsoft, Bellevue, WA, and Business Microproducts, Livermore, CA (who have had their separate TRS-80 COBOL compilers on the market for several months), are satisfied with their sales. Business Microproducts' Jim Smith says that they have found a market among high schools "and even universities" that are teaching COBOL programming. Mike Orr of Microsoft explains that despite a low advertising take off, their \$750 compiler has "sold in the dozens in its first two months on the market."

But unless the COBOL standards are quickly clarified, it's doubtful that the advent of COBOL for the TRS-80 will have the immediate and dramatic impact on the business market that many people are expecting. Those thousands of existing business programs can't be run on the TRS-80—yet. ■

By Nancy Robertson
80 Staff

Confused by the New Level II Two-chip ROM?

Know what? Radio Shack is selling a revised two-chip version of ROM for Level II BASIC machines. These new 6K chips have given some users problems because the new ROM does not function in quite the same manner as the old.

In their monthly newsletter, *Microcomputer News*, Radio Shack ran a list of command corrections for the new ROM, and some other interesting tidbits. They are rehashed here in an effort to clarify the confusing situation which has resulted from the introduction of this new two-chip ROM.

First, the new power-up query is: MEM SIZE? The BASIC sign-on prompt is: R/S L2 BASIC. The memory space saved by condensing these messages is now devoted to a key-bounce fix. The old KBFIX keyboard driver is no longer necessary and will not work with the new ROM.

Second, free memory space has been reduced by two bytes resulting in a 15570 answer to the MEM? query in a 16K machine.

Third, one can no longer CLOAD from either tape input when an expansion interface is being used. Only tape drive number one may be used. CSAVE#-N procedures still allow the operator to select the destination drive in multi-recorder set-ups, however.

Fourth, pressing SHIFT and the down arrow simultaneously will result in control characters. You are in the control mode as long as both keys are depressed.

Fifth, you can now perform multiple PRINT@ operations by simply constructing your print statements as follows:

```
PRINT@10,"A",@50,"B",@200,"C"
```

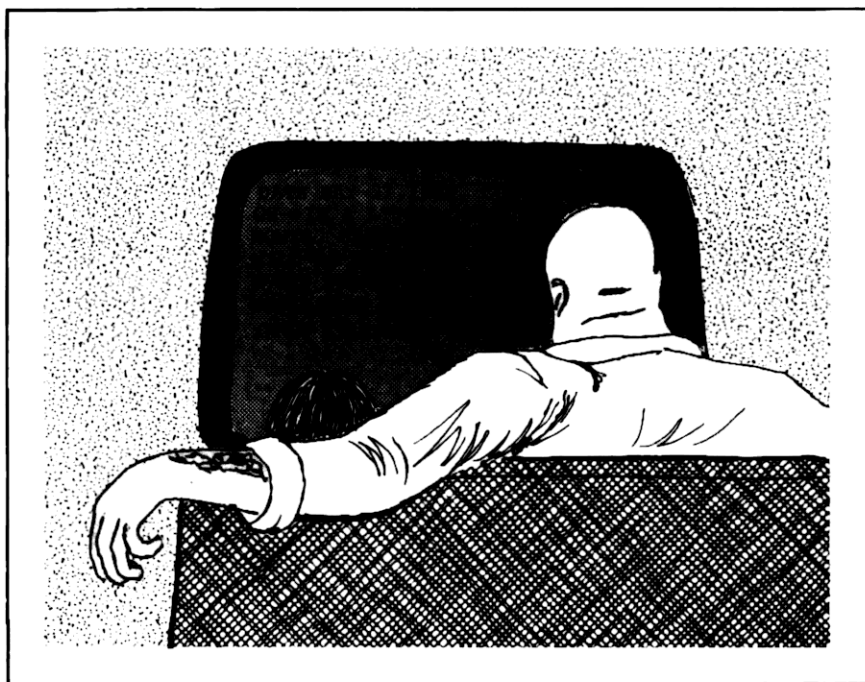
In addition, about ten of the Shack's tapes will not CLOAD with the new ROM. If you encounter this situation, a new tape will be supplied by Radio Shack.

This ROM is not interchangeable with previous ROMs. If you want it, be prepared to shell out \$150 (Level II) for a complete conversion kit. The kit is only available as an installed modification and, as one might expect, only certified Radio Shack service centers will be doing the installations. Installation is extra by the way, but how much extra is not mentioned. The model number for the new Level II ROM is #26-1120, and it is available now. ■

By Chris Brown
80 Staff

Please Be Patient

At 80 Microcomputing we are undergoing some staff changes that have resulted in a backlog of mail and manuscripts. We are reading manuscripts as quickly as possible. The editors apologize for any delay.



The Infancy of Electronic News Delivery

July 1, *The Columbus Dispatch* became the first newspaper in the country to offer electronic home delivery. Owners of microcomputers can now dial their phones, connect their modems and read the evening news from their video screen.

The Dispatch is one of 11 Associated Press (AP) newspapers which will be offering electronic home delivery through the CompuServe, Inc., Columbus, OH, data network. The other papers which will participate in electronic delivery are: *The Washington Post*; *The New York Times*; *Chicago Sun Times*; *The St. Louis Post-Dispatch*; *The Minneapolis Star and Tribune*; *The Norfolk Virginian-Pilot and Ledger-Star*; *San Francisco Chronicle* and *The Middlesex News* (Framingham, MA).

CompuServe's president, Jeffrey Wilkins, explains that the 11 papers were chosen from more than 40 that were interested. Several of the publications are expected to join *The Dispatch* in electronic delivery sometime in September.

July 14 Knight-Ridder Newspapers, Inc. also began electronic delivery of their paper on an experimental basis in 30 homes. Calling the project Viewdata, Knight-Ridder is working in conjunction with American Telephone and Telegraph.

However, because microcomputers do not need to be dedicated to data sharing only, the prospects for the future of electronic delivery seem more likely to pivot on the reception of the CompuServe program. There are 1,300 daily papers and 3,500 radio and television stations who own AP. Most of them are curious: Does the public have any interest in microcomputer, electronic delivery of the news?

As it stands now, electronic delivery through

CompuServe begins with a local phone call from the subscriber, answered by a local computer, which in turn communicates with CompuServe's data base in Columbus. Via telephone wires and modems, news enters the home microcomputer at 300 words per minute. A directory or menu allows users to scan news sections and headlines. Stories can be called, read, saved or printed from each section.

However, computer subscribers will have to say good-bye to Mary Worth, Steve Canyon and Charlie Brown. The comics, political cartoons and photographs will not be transmitted.

For the time being, advertising is also absent from computer editions. Advertising generally accounts for about two-thirds of newspaper revenues. Although electronic delivery may prove less expensive than paper printing, it is argued by many people in the business that new concepts in advertising will be vital to the survival of computer news delivery.

The Dispatch has already made plans to incorporate classified ads in their CompuServe edition. They are also working on an advertising index system that will make it possible for space advertisers to sponsor several articles.

Philip Meyer, marketing director of Knight-Ridder's Viewdata project, does not believe computer delivery will completely replace paper delivery. "The newspaper is not an inefficient information retrieval device," he said. "You can scan it very quickly. The main threat to newspapers is not competition for information, but competition it (data sharing) provides for advertisers."

Publishers and advertisers may adjust to electronic delivery of the news, but what will become of Sundays without the Sunday comics? ■

NEW PRODUCTS

Utilities for Businesses

ACCT-M2 from Micro Architect, Inc. consists of five programs that carry out the on-line accounts receivable functions of a small business or a medical clinic.

The three basic functions are initialization, data base management and report generation. Initialization allows users to specify the system parameters, such as company name and address, late charge policy, etc. It also can sort the customer names or change most of the system parameters. The data base management lets users add, inquire, delete and adjust transactions and customer information.

Reports consist of sales journal, receipts journal, aging analysis, end of period processing, data base listing, labels, statements and deleted customer reports. A consistency check is included.

ACCT-M2 is priced at \$149, including a disk and user's manual. The user's manual is available separately for \$5. A simplified version of the program is available for the Model I and costs \$69.

L216 is another business package from Micro Architect for systems with at least 16K and Level II BASIC. It consists of the following programs: a cassette data base manager, a word processor, an inventory control system, a stock management program, a check balancing program, a label printer, a deposit calculator, a statistics program, a sort utility and a key-access utility.

The complete package costs \$59.

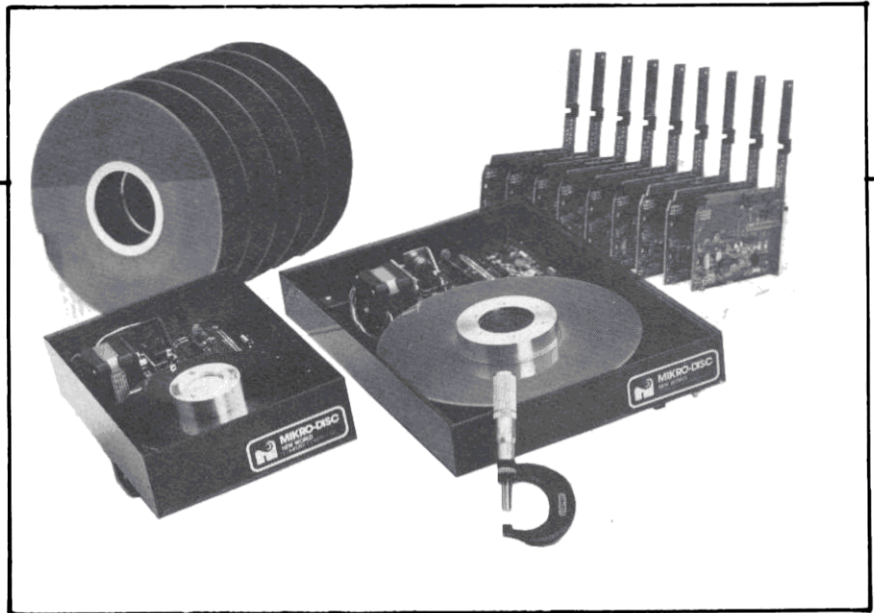
For more information on either of these products, contact Micro Architect Inc., 96 Dothan St., Arlington, MA 02174.

Reader Service ✓ 174

Color Graphics Circuit Board

Integrated Service Systems, 1011 W. Broadway, Minneapolis, MN, 55411 is selling a TRS-80 color graphics circuit board. It is designed for use with a standard color television receiver and a 4K to 48K Level II. The board is sold in two different packages: Model C-2000 and Model C-1000. Both include all electronic components. Minor assembly is required to complete the RF modulator section.

Models C-2000 and C-1000 are fully buffered and expanded to ten display modes. ASCII and eight-color semi-graphics can be mixed on the screen. Five four-color graphics modes and four two-color graphics modes are included.



Mikro-disc Disk Drives

COLPRT is a machine language program that allows ASCII and semi-graphics information to be displayed by LPRINT. COLSCREEN is the program which transfers the TRS-80 graphics to a color screen. (COLSCREEN is not available yet, but is expected to be on the market by October.)

Model C-2000 includes the circuit board, COLPRT and power supply for \$189.95. Model C-1000 costs \$129.95 for the circuit board and software without the power supply.

Reader Service ✓ 333

80 Music Synthesizer

Software Affair, Ltd. is selling Orchestra-80, a TRS-80 music synthesis system written for a 16K Level II TRS-80. The system consists of software and hardware.

The software is a five part machine language program: a digital synthesizer which produces four simultaneous voices in a six-octave range; a music language compiler, a full function text editor with blinking cursor, and a file manager.

The hardware is a single 1 1/2 by two inch PC board, completely assembled and tested, which plugs into the expansion connector of the TRS-80 keyboard or the screen printer connector on the expansion interface.

Tape and disk versions are supplied on cassette, with sample music programs. For more information, contact Software Affair, Ltd., 473 Sapena Court, Suite 1, Santa Clara, CA 95051.

Reader Service ✓ 340

Production to Begin on New Winchester Drives

New World Computer Company, Inc., 3176 Pullman St., Suite 120, Costa Mesa, CA 92626, has added the Minimikro-disc V Series of 5 1/4-inch fixed disk drives and an enhanced double-density system called Mikro-disc VIII-ITF to its product line.

According to the company, standard 5 1/4-inch floppy disk drives have an average access time of 298 milliseconds. The Minimikro-disc V-ITF can access data in an average of eight milliseconds.

The original Mikro-disc 211, has doubled storage capacity and has been renamed the Mikro-disc VIII-ITF.

The Minimikro-disc V-ITF and Mikro-disc VIII-ITF are priced at \$700 and \$1100 respectively, in dealer quantities. Production is scheduled to begin by the end of the year.

Reader Service ✓ 328

VTOS 4.0 Plus Manual

Virtual Technology, Inc., Dallas, TX 75234, has a new disk operating system available, the VTOS 4.0.

VTOS 4.0 will support five inch (35, 40 or 77 tracks), eight inch (single or dual density), or ten M hard disks. Speed-up kits that are on the market will also be supported. Backup is simplified so that users only need to indicate the type of drives used. Improved chaining offers 15 chaining commands that can handle most

I'M A BELIEVER !!

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Now I see why people who have seen it say they are now
believers. I know I am."

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- 1) Large (8") drive support.
- 2) Double Sided drive support.
- 3) Double Density drive support.
- 4) 80 Track drive support.

*NOTE: all above drives may be mixed on any one system and can be configured at Sysgen time or during any Backup!

5) Winchester technology fixed drive support.

6) Supports any combination of the above drives up to a max. of 8 drives.

7) Supports double-speed processor clock modifications. (Archbold for example)

8) FASTER! — Improved overlay structure using ISAM accessing techniques improves loading times by up to 1400%.

9) General purpose output spoolers of a true, symbiont design provide simultaneous output and program execution without any user intervention.

10) Keyboard Type-Ahead feature permits you to enter keystrokes before your programs need them.

11) User definable keys, all 26 letters.

12) Built in Graphic string packer lets you enter graphic symbols into a BASIC program from the keyboard through the use of the (Clear) key. The (Clear) key is simply held down (just like the (Shift) keys) during other keystrokes and viola...graphics!

13) Dated files. — All files are accompanied by the date of their last modification (creation or write).

14) Marked files. — All files are accompanied by a 'mark' if they have been modified since they were last backed up. This permits the BACKUP utility to copy only those files which have actually been updated since a previous backup.

15) File transfer by class. Allows transferring of all files of a similar directory classification such as /CMD, /BAS, /PCL, etc.

VTOS 4.0

VTOS 4.0

Operating System
Diskette with
Operator's Guide

\$99.95

VTOS 4.0

Master
Reference Manual

\$29.95

VTOS 4.0

Combination -
4.0 disk,
Operator's Guide,
and Master

Reference Manual

\$125.00

16) Built-in SYSTEM command contains lower case display driver, screen print, break key disable, blinking cursor, disk drive stepping rate and motor-on delay modifications, and more.

17) User may SYSGEN a custom VTOS system configuration containing special I/O drivers, device LINKing and ROUTing, SPOOLing and DEBUG tasks, etc. which will be automatically loaded during the BOOT process without requiring a more lengthy AUTO and CHAIN procedure.

18) Non-BREAKable AUTO and CHAIN commands.

19) Wild-card DIRECTORY. Permits you to locate all files of a certain classification such as '/BAS'. Uniformly indicates file size in K (1024 bytes) regardless of drive type. "DIR D" would give you all your files that start with "D".

20) Dynamic file name defaults in APPEND, COPY, and RENAME commands allow you to specify only minimal information about file names.

21) COPY and APPEND commands execute up to 300% faster.

22) ALLOCate command for pre-allocation and non-releasability of file space. File space will never shrink if this option used.

23) MEMORY command for directly setting upper memory limit.

24) Variable Length file support is incorporated which automatically blocks short user data records both within a sector and across sector boundaries thereby taking maximum advantage of disk file space.

25) No security disk needed to make backups or to run the system!

26) Though many O/S bear his design and code VTOS 4.0 is the only Fully Approved Operating System by Randy Cook! And it is FANTASTIC!

27) Endorsed by Scott Adams and Lance Micklus!

VTOS and VTOS 4.0 are registered trademarks of VIRTUAL TECHNOLOGY, INC. - Dallas, Texas 75234

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after 8:00 - same number
as FORUM 80. (SOURCE - TCC957)



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NEW PRODUCTS

types of routines, including timed functions.

There is a built-in graphics screen packer. Graphics can be designed on the screen, listed and combined with BASIC LOOK-AHEAD.

Printer and keyboard speed buffers make it possible to use the system for two functions at one time. For instance, it is possible to operate the printer and run a program simultaneously.

The VTOS 4.0 Master Reference Manual claims to offer "the detailed handholding information that so many people have been asking for."

Together, the manual and VTOS 4.0 are sold for \$125. The manual is available separately for \$29.95.

Reader's Service ✓ 330

Speed Loading Cassettes

Personal Micro Computers, Inc. (PMC), 475 Ellis St., Mt. View, CA 94043, is selling Fastload to input cassettes to Level II computers at one kilobyte per second. PMC claims this is 16 times the normal speed. Any cassette saved at normal speed (500 baud) can be loaded with Fastload at 800 baud.

Unlike other high speed program loading devices, Fastload does not require transferring programs to another media first. This PMC product is also able to search for BASIC programs at high speed, but it does not provide for high speed recording of cassettes.

The Fastload cassette interface plugs into either the back of the TRS-80 Level II 16K keyboard or expansion interface. PROM memory is located above ROM and below RAM. It also contains a keyboard debounce program.

A CTR-41 tape recorder must be used with Fastload. Modifications must be made on standard CTR-41s with instructions provided; a new recorder with the modifications is sold by PMC for \$95. The Fastload cassette interface is sold for \$188.

Reader Service ✓ 349



Fastload Interface and Cassette

Model II System Monitor

RSMII is a relocatable system monitor for the Model II sold by Small System Software, P.O. Box 366, Newbury Park, CA 91320.

RSMII includes commands to insert breakpoints, dump memory in hex and ASCII, test, search, modify, verify, zero and fill memory, etc. These features are also included in the company's Model I system monitors.

Features that are new with the RSMII include a video editor to modify both memory and disk sectors. Disk commands can access four drives and can read and write single and double-density disks. There are controls for split screen scrolling and adjustable scroll speeds.

RSMII will operate printers through either parallel or serial printer ports at baud rates from 110 to 9600. An image of the screen may be printed at any time. Page-length control and RS-232-C handshaking are supported.

The system monitor comes on a self-booting disk with a relocater. It is sold for \$39.95 with an instruction manual.

Reader Service ✓ 167

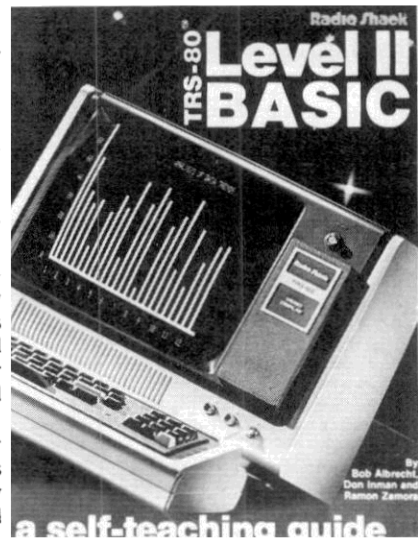
General Ledger System

Sturdivant & Dunn, Inc., 124 Washington St., Box 277, Conway, NH 03818 is selling Full Charge Bookkeeper, an advanced general ledger system for small businesses.

It gives users an efficient method of posting income, expense and adjustments to obtain financial statements plus cumulative detail on an annual basis. It can handle 12 characters of alpha and 4520 posted entries in up to five departments.

Full Charge Bookkeeper is written for a TRS-80 Level II with 48K, three disk drives and printer. The package, which includes manual and programs is priced at \$199.95. It will be sold for \$129.95 through September as an introductory offer.

Reader Service ✓ 181



Radio Shack's Self-teaching Guide to Programming

RS Game and Guide

A new game from Radio Shack, Dancing Demon, displays an animated figure dancing to music that can be heard by connecting the computer to an amplifier and speaker. The program is supplied on cassette and includes two preprogrammed selections. The user can also program other tunes of up to 248 notes and choreograph dance routines to go with the music.

The program is designed for a Model I Level II TRS-80 with at least 16K RAM. It is priced at \$9.95.

Radio Shack also has a compact 200 mW speaker-amplifier that can be used to produce the musical accompaniment for Dancing Demon. The Realistic Micro-Sonic Speaker-Amplifier is priced at \$11.95.

TRS-80 Level II BASIC, a self-teaching guide to programming and using a Level II microcomputer, is another new product from Radio Shack. Each chapter is composed of short, numbered sections which present ideas or topics on BASIC, the TRS-80, or a program that is being developed.

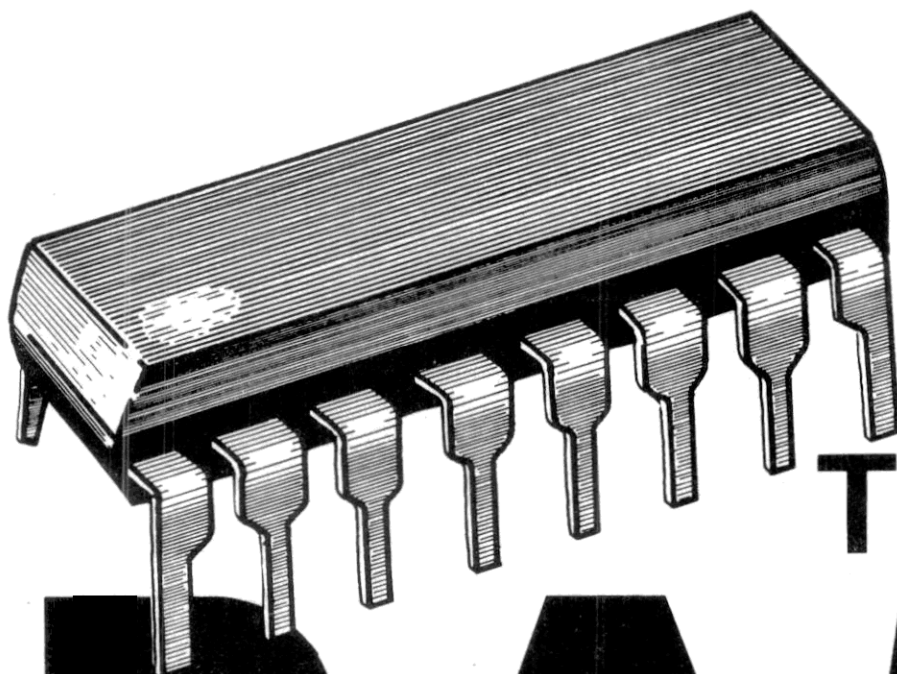
TRS-80 Level II BASIC, is priced at \$9.95.

Reader Service ✓ 326

Time-sharing Peripheral

The Micromint Inc. is selling a new data communications product, the Chatterbox. The Chatterbox is a combination of the presently available Comm-80 I/O interface for the TRS-80 and an acoustic modem, to turn TRS-80 into a timesharing terminal.

The Chatterbox includes a built-in programmable 50-19200 baud serial port, a Centronics compatible parallel printer port, a 300 baud acoustic originate modem, and a spare TRS-BUS expansion connector.



TRS-80*

RAM

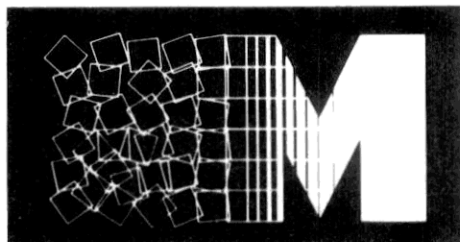
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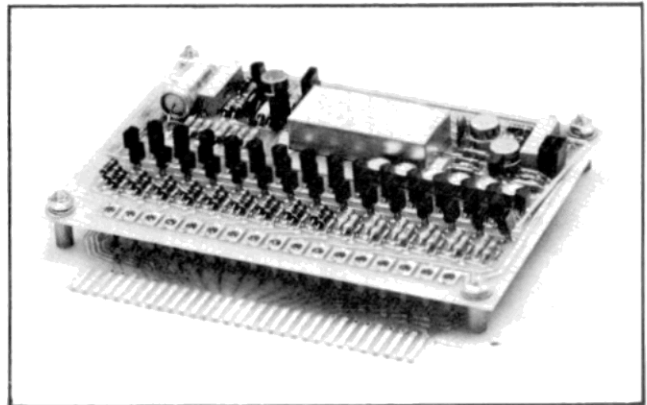
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NEW PRODUCTS



Comm-80 of Chatterbox Package



Model 1555S Analog-to-digital Converter

It comes with power supply, connection cable, user's manual, and terminal software for immediate operation. It is hardware and software compatible with existing TRS-80 products and connects either to the keyboard connector or screen printer port on the RS expansion interface. It does not require the RS expansion interface for operation.

The Chatterbox is sold for \$259.95 from The Micromint Inc., 917 Midway, Woodmere, NY 11598.

Reader Service ✓ 329

TRS-80 to H-14 Interface

The Model PTS-3 (for use with an expansion interface) and the Model PTS-4 (for use without an expansion interface) are printer interfaces from Multi Media Systems. They make it possible to connect the TRS-80 microcomputer with the H-14 Serial Printer.

The PTS-3 plugs into the parallel printer port of the TRS-80 interface. The PTS-4 can be used with the PTS-3 in systems that do not include a Radio Shack expansion interface. The H-14 is connected to the DB-255 connector of the PTS-3.

A software driver is not needed with this system, because it will support all printer commands in BASIC or machine language.

The PTS-3 and the PTS-4 are each priced at \$73.45 for an introductory period from Multi Media Systems, P.O. Box 41081, Indianapolis, IN 46241.

Reader Service ✓ 338

E.S.P. Lab for Research

E.S.P. Lab has been designed by Manhattan Software, Inc., P.O. Box 5200 Grand Central Station, New York, NY 10017, as a program for research into possible extrasensory phenomena, as well as for casual testing of the possibility of telepathy, clairvoyance, precognition and telekinesis.

Based on Duke University experiments,

E.S.P. Lab selects randomly from among a set of five symbols (square, triangle, cross, wavy lines and oval), presenting one symbol at a time on the screen for telepathy experiments. All symbols are programmed in machine language and appear on the screen instantaneously. For clairvoyance and precognition testing, the program selects the symbol before or after the response, prompting only with a question mark on the screen.

Complete records are kept in memory of each symbol and response for a series of ten trials of 25 symbols each. Tables of results are constructed, with analysis of matching symbols and responses. For TRS-80 Level II 16K, E.S.P. Lab costs \$9.95.

Reader Service ✓ 339

Packing Program

Data Assoc., Box 882, of Framingham, MA 01701, has released Pack8, designed to pack BASIC programs for faster loads and runs. Pack8 can reduce memory as much as 40 percent.

Pack8 is written for 32K and 48K Model I computers using one disk drive. All the lines in the program can be compacted, or a block of inclusive numbers. At the end of the packing, a summary is presented of the number of bytes and lines in the original program.

Pack8 is provided on cassette with instructions, and is sold for \$19.95.

Reader Service ✓ 169

1555S Analog-to-digital Converter

Tustin Electronics Co. has added the Model 1555S to its series 1500 analog-to-digital converter product line.

The new model provides a complete conversion of an analog voltage to a 15-bit digital number in less than five microseconds. It is a monotonic unit.

The Model 1555S can be used by itself or

with other analog modules to form a complete system. The converter price is \$1500 from Tustin Electronics, 1431 E. St. Andrews Pl., Santa Ana, CA 92705.

Reader Service ✓ 327

Software Programming Tools

PROgrammer by Rational Software, 963 E. California Blvd., Pasadena, CA 91106, provides professional-quality programming tools to users of Level II BASIC.

After a short machine language routine is read, five functions are continuously available. A single keystroke directs keyboard input, which interprets and executes the command line. After execution, control is automatically returned to Level II BASIC.

The program also includes a keyboard debounce routine. PROProgrammer costs \$25.

Reader Service ✓ 336

Property Management System

A-T Enterprises has a new income property management software package for TRS-80 Model II. The Property Management System (PMS) is designed to meet the Institute of Real Estate Management recommended computer system capabilities.

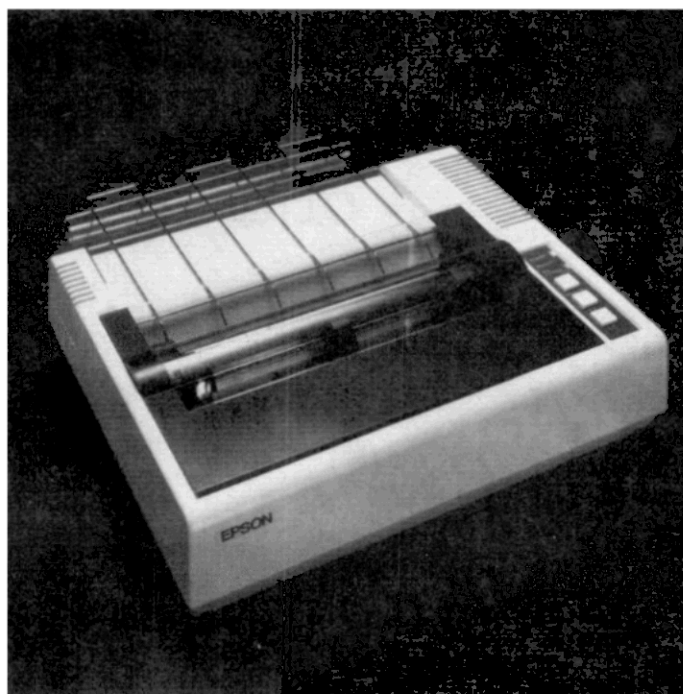
It is suitable for all types of income properties including apartments, mobile home parks, office buildings, warehouses, etc. The system is a full general ledger system that keeps track of all income and expenses providing formatted financial statements, management reports and exception reports upon request.

The PMS software operates on the Model II with 48K of RAM, two eight inch disk drives and a printer. It is written in CBASIC, runs under CP/M and is also compatible with most Z-80 and 8080 systems.

PMS, including one year maintenance, costs \$650. A demonstration disk is available for \$35 from A-T Enterprises, 221 North Lois, La Habra, CA 90631.

Reader Service ✓ 332

If you
just bought
another
printer,
boy are
you gonna
be sorry.



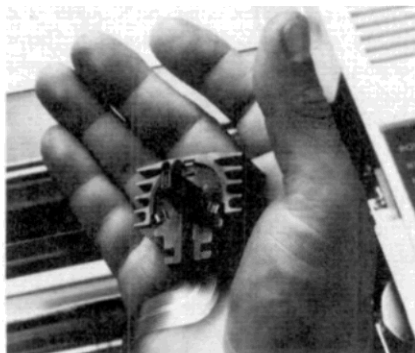
Epson.

The Epson MX-80. It's not just another worked-over rehash of last year's model. It's our top-of-the-line 80-column printer. It's new. From the ground up. And it's the most revolutionary printer to hit the market since Epson invented small printers for the 1964 Olympics in Tokyo. Don't take our word for it, though. Compare. There simply isn't a better value in an 80-column printer. Period.

But here's the fact that's going to stand the printer world on its ear. The MX-80 sports the world's first *disposable* print head. After it's printed about 50 million characters, you can throw it away. Because a new one costs less than \$30, and the only tool you need to change it is attached to the end of your arm.

Now that's revolutionary, but that's only the beginning. The MX-80 also prints bidirectionally at 80 CPS with a logical seeking function to minimize print head travel time

The world's first disposable print head. It has a life expectancy of over 50 million characters, yet it's so simple, you can change it with one hand. And it costs less than — repeat less than — \$30.



and maximize throughput. It prints 96 ASCII, 64 graphic and eight international characters in a tack-sharp 9x9 matrix. And it provides a user-defined choice of 40, 80, 66 or 132 columns and multiple type fonts.

We spent three long years developing the MX-80 as the first of a revolutionary series of Epson MX Printers. We employed the most advanced automatic assembly and machining techniques in existence to produce a printer that is incredibly versatile, remarkably reliable and extraordinarily inexpensive. It's a printer that could only come from the world's largest manufacturer of print mechanisms: Epson.

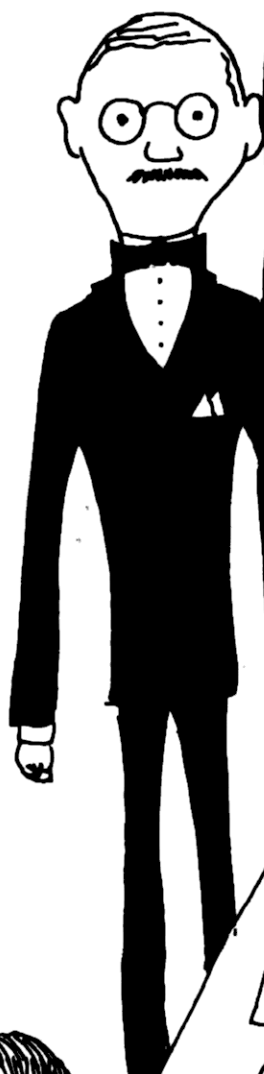
If it sounds like we're proud of the MX-80, we are. Not only does it do things some of the world's most expensive printers can't do, it'll do them for you for less than \$650. That's right. Under \$650.

And if that isn't revolutionary, we don't know what is.

404

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Practical Pointers

Take a look at the sockets at the back of your 80. They are European DIN-type sockets and match five-pin plugs. There are three of them, one each for power in (from the transformer unit), cassette in/out (I/O) and video out.

Before you start using your 80, take the advice of an old hand and label these plugs and sockets with differently colored tapes. I use red for the power plug, green for video and yellow for the cassette. If your 80 sits in the same place and you never unplug it, this isn't significant. The odds are, however, that some day you'll want to shift it, and you could easily end up with plugs in the wrong sockets, since they are identical and easily confused in poor lighting conditions.

Keeping your system cool is another useful tip. Try not to have a desk lamp shining on the keyboard, for instance. It doesn't help, either, if you've used the computer all day with bright sunlight heating up the keyboard casing and the electronics inside. High temperatures also damage cassette recordings.

I've found that a normal room temperature of 70-75 degrees won't cause the TRS-80 any distress, even if you use it all day. It's another story if you have an expansion unit attached, but we won't go into that. Just make sure that that little black box which is the transformer unit is on the bench or on the floor, with room for air to circulate around it; don't put it inside a box or surround it with books.

Power It Up

You're ready to power up. Plug all the line plugs into the wall sockets and switch on. DON'T switch on the keyboard first—always have power on the cables before you turn on the

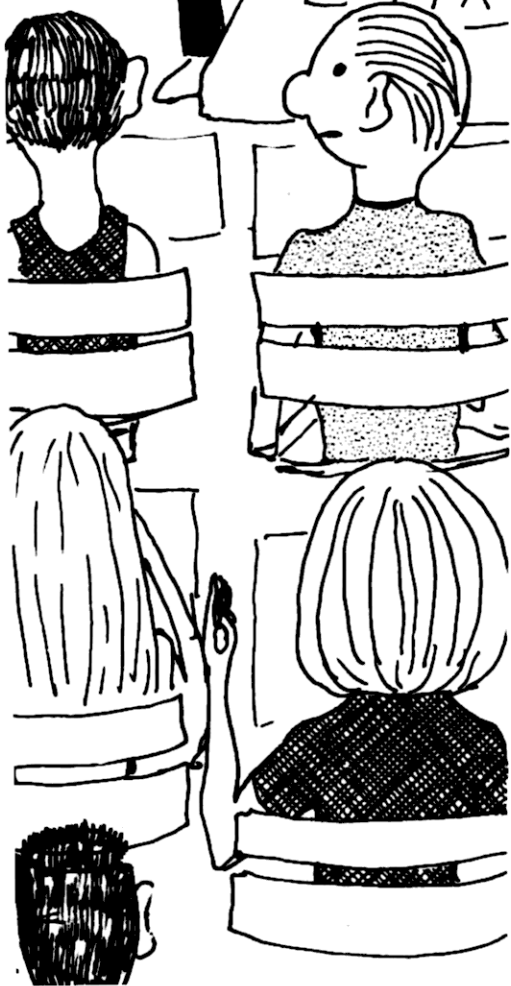
Many articles are written for those of you who have owned a TRS-80 for some time and know what programming is all about. So, this series is dedicated to the thousands of readers who are just about to buy a TRS-80—or have just bought one—and want to know what they've gotten into.

Throughout the series, we'll be talking about the Model I Level II TRS-80. Level is Tandy's word to indicate the complexity of programming language its computer is able to understand. We're dealing with the Level II only for two good reasons. First of all, Level II is much more useful. And, secondly, the Level I computer is already accompanied by an excellent manual for the beginner.

One measure of a computer's power is its memory. Memory dictates the amount of information (data) a computer can store and is measured in units called kilobytes, shortened to K. The 4K computer can store four kilobytes of data. Nothing in this series will cause you to run out of memory space on a 4K TRS-80.

Before you proceed, be assured of one point. The computer does exactly as you instruct it, nothing less, nothing more.

If you have not put in the instructions to print letters or numbers on the video screen, then these letters or numbers just don't get printed. One of the humiliating things about being a computer owner is knowing that whatever goes wrong is your fault.



"If you have not put in the instructions to print letters or numbers on the video screen, then these letters or numbers just don't get printed. One of the humiliating things about being a computer owner is knowing that whatever goes wrong is your fault."



units, because the switch for the keyboard does more than just switch power.

Start the countdown by switching on the monitor. (On the one I use, the brightness control must be pulled to switch on.) Let the monitor warm up for a minute, then switch on the computer keyboard. The ON/OFF switch is at the back, next to where the power supply plug enters the casing. It's deliberately made a bit hard to find, because when you switch off a computer, all the program material you had stored in it is lost, gone forever, unless you recorded it on a cassette previously.

As you press the ON/OFF switch, you'll see the video screen suddenly filled with a mixture of numbers, letters and odd shapes. That's "garbage," caused by the computer memory being activated. Each little cell of memory can store a bit of information; zero voltage represented by a zero, or +5V represented by a 1.

Upon power up, when all of these cells are activated, some come on as 1s, some as 0s. About 8192 of these memory cells send signals to the video screen, the cells which are set to 1 cause parts of the video screen to light up, and the cells which are left at 0 keep the screen dark.

The result is a display of light and dark pieces at random or almost at random. Circuits inside the computer force these light and dark places into patterns, the patterns which we call letters, numbers and graphics blocks, and this is the pattern we see just as we depress the ON/OFF switch. When you release the power switch, the garbage clears, because the switch operates a memory clear routine for the video screen and memory—that's why it isn't a good idea to switch the keyboard on before plugging in the line and powering up.

The Mystery Message

Shining on the video screen in all its glory is the message MEMORY SIZE ? It has floored many a beginner. Did no one back at Fort Worth tell the machine what its memory size is, you ask? Ignore it for the moment, press the ENTER key, and these more reassuring words appear:

```
RADIO SHACK LEVEL II BASIC  
READY  
>
```

Your computer is prepared for programming in the BASIC program language.

What about the MEMORY SIZE? message? Well, as it happens, a lot of computer tasks can be performed faster and more efficiently by giving instructions directly to the microprocessor chip inside the computer. This chip needs special instructions, called machine code or object code, and these instructions can't be loaded into the computer in the same way as an ordinary BASIC program.

Unless you're going to use machine code programs right away, though, you can ignore the MEMORY SIZE? question.

The one time you can't ignore it is when it appears while you're running a program. When that happens, it's an unwelcome sign, called a re-boot, that something is very wrong with your program. The computer has started its power-on sequence again. There's no harm in it, but you will have lost your program unless you saved it on cassette earlier.

The READY signal is an invitation, but unless you know what it's inviting you to do, you can't take advantage of it. At the READY signal, you can either load a program from a

cassette or you can type one yourself. Since you'll learn more about the 80 from writing your own programs, however simple, we'll start there and leave the frustrations of cassette loading for a later date.

READY is an invitation for a BASIC program. BASIC is an acronym for Beginners All-purpose Symbolic Instruction Code, and it's the easiest of programming languages to learn.

Why should we have to learn BASIC?

It's all bound up with the way computers work and are designed. The fastest and most efficient programs are written in machine code, but learning and using machine code is a painful business, and writing machine code is a frustrating experience.

For these reasons, computer designers have continually sought to make it possible to give instructions in simpler forms, using English words (or Spanish, French, Italian and others) and stringing them together in a way which is reasonably simple to understand.

If you've looked at some of the programs printed in the back of the TRS-80 Manual or published in *80 Microcomputing*, you might not quite believe this last statement, but compared to most other computer languages, BASIC is reasonably easy to understand. We can devise simpler languages, but the penalty for using a simpler language is either that it doesn't do as much as we would like, needs more memory or takes longer to run. Right now, your TRS-80 comes with its BASIC language built in.

Like any other language (and I've had to cope with Latin, French and Greek in my time), BASIC is best learned by using it. Unless you intend to use your computer simply to run programs written by other people and obtainable

on cassette, you haven't much choice—learn BASIC!

Unlike other computer languages, BASIC isn't standardized. A program written in BASIC for another computer may not run on the TRS-80, and vice versa, unless you make a few changes.

It is possible to write BASIC programs that will run on any computer equipped with the BASIC language (the Adam Osborne programs are good examples of this), but you can get a lot more out of your 80 if you know the peculiarities of its dialect of BASIC.

This dialect, incidentally, is one of the most advanced BASICs fitted to a small computer. We can't hope to show all the features of BASIC programming in this series, but we can try to fill the gap between elementary BASIC textbooks and Radio Shack's *Level II Reference Manual* that comes with your computer.

Program Proverbs

If you've never programmed a computer before, learning BASIC on your own can create as many ulcers as guarding a bank during a revolution. Computers are fussy about the way you use the language. If the manual says that a word must be followed by a comma, then it really must be followed by a comma, or your program won't run.

If, on the other hand, a word needs a semi-colon after it, you can't get by with just a comma or a colon. This punctuation is translated into instructions by the computer, and different marks denote different instructions.

Translated? That's just what happens. There are about twelve thousand bytes of memory inside your TRS-80 which you can't alter. The professionals call it ROM, or read-only memory. It reads your BASIC program and converts each letter or word into machine code instructions to the microprocessor. Because each instruction is converted and then carried out, the instructions are much more long-winded than those in a machine code program.

Bigger computers can do what's called compiling, which means translating the entire pro-

gram into machine code in one run, and then running the machine code. The TRS-80, like all small computers, only interprets—it converts each instruction in the BASIC program into code, runs it and then goes on to the next part. The difference is between dictating directly to a secretary, with all the um's and er's of speech and delivering an edited tape to an audio typist.

Let's start again with the READY signal staring us in the face. Your first response toward writing a program is to type a line number. The line number is a tag we can attach to an instruction so that we and the computer know where to find that instruction.

Take any number between 1 and 65529. Normally, you start at 10 or 100. It doesn't matter what numbers you choose, since you don't use more memory by numbering lines 100, 200, 300 than by numbering them 10, 20, 30. Important to remember is that the program should flow from the lowest numbered line to the highest.

Since we have to start somewhere, type 10 and a space. Your program now starts at the line numbered 10. Since it's a bit depressing to stare at a blank screen, we'll get the computer to PRINT my name.

```
10 PRINT "IAN R. SINCLAIR"
```

Remember, the quote marks must be in place, because they indicate to the computer that the words between them are to be printed on the video screen and are not part of an instruction. Marks that divide one kind of word from another are called delimiters, and the quote marks are the easiest of these delimiters to work with. Make sure that anything you want printed to the video screen starts and ends with quote marks.

Made a mistake? We're not all trained typists, so the TRS-80 is very forgiving. Use the backspace, the arrow which points to the left, on the key next to the @. Each time you press this key, one letter of your instruction is wiped out, and you can type another one. Keep on until the line is perfectly typed.

Now that you've typed the line, you must press ENTER to make certain that it's planted in the computer's memory. Even if you forget the line number, you still get a result—the words which were inside the quote marks will be printed, but you don't have a program because it won't repeat, and you must start again. If your line was entered correctly, it is now a very simple program. We can run the program by typing the word RUN and then hitting ENTER again.

All right, so it's not impressive, but each time you type the word RUN and hit ENTER, you'll get my name printed on the screen. Makes me feel good at least.

Try typing the instruction with no space between the 10 and the PRINT, so that it reads 10PRINT "IAN R. SINCLAIR". Does it make any difference in the way the program runs? Did I say that computers were fussy?

Now type LIST10 and hit ENTER. This prints your instruction line on the screen again. Notice anything about it? Right, the space has been put in again between the 10 and the PRINT. You can't cheat your TRS-80 this way!

Now try some more deliberate errors. It's just as well to know at this stage what effects they have, rather than be tangled up with an unfamiliar error message later on. For a start, leave out the first set of quote marks. Then try typing PPRINT or PRIINT instead of PRINT. Doesn't run, does it?

Instead, you get the words SN ERROR. SN is a shortened version of SYNTAX, a word that language teachers use to mean the way in which a language is constructed. If you say in English, "I am here since yesterday," your syntax in English is poor, but the same phrase in French is grammatically correct.

Syntax is a matter of rules, and a SN error means you have broken a rule of BASIC, by leaving out a delimiter, or misspelling an instruction word. Some newer computers, incidentally, reject a syntax error the moment it is entered, but the TRS-80, like its entire generation of home computers, doesn't spot the error until you try to RUN.

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See reviews in July 80 and August 80 BYTE By Jerry Pournelle.



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✓367

How much can you PRINT in one instruction? Try it! Type 20 PRINT “. . . .” and then type as many words as you like. You’ll find that the words don’t run off the edge of the video screen, but form new lines of text on the monitor. The video monitor accepts only 64 characters/line, while the computer allows up to 250 characters/line. The computer no longer responds to keyboard input when the 250 character limit is reached.

PRINT Plus Spaces

Now try the one-liner below:

```
10 PRINT“    SPACED ALONG”
```

Because we’ve labeled this line as line 10, it has wiped out the old line 10. Notice that the

space between the first set of quote marks and the first letter of the word affects the way it prints. This is one way of adding spaces.

Another way is by indicating tabs. Tab means the same as it does on a typewriter, tabulation. The width of the video screen is divided into 64 starting points, numbered from 0 to 63. Using TAB() selects one of these as a starting point for what you print.

```
10 PRINT TAB(25)“IN THE CENTER”
```

Notice the syntax—parentheses after TAB enclose the number, between 0 and 63. The quote marks surround the words to be printed.

If you had put the first set of quote marks between PRINT and TAB, you would have printed, at the left-hand side of the screen, the phrase

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TAB(25) IN THE CENTER, which isn’t exactly what we wanted.

Why TAB(25)? Well, I counted the letters and spaces in IN THE CENTER and made it 13 characters. I rounded that to an even number, 14, then subtracted from 64, leaving 50. Half of 50 is 25, and that’s the tab number. Why? Well, the number of letters and spaces gives the number of positions on the line which are used to print. If we want these words to be centered, then there has to be an equal number of spaces on each side, and we find this by dividing the number of unused places, 50 in this example, by two.

Try printing your own name centered on the screen.

Notice, by the way, that we’re still entering each one-line program as line 10, deleting the previous program in line 10. Later on, we’ll look at other ways of removing old programs, getting rid of unwanted lines or running only the lines we want.

TAB is one of the BASIC commands or functions that not all small computers have, but it’s only the start of the options which are available to the TRS-80 owner. Type the next line very carefully.

```
10 PRINT “SPACE”, “THE”, “WORDS”, “OUT”
```

See the commas? Each comma lies outside the quote marks that set off the words, because we don’t want the commas printed. If we type:

```
10 PRINT “SPACE, THE, WORDS, OUT”
```

hit ENTER, type RUN and hit ENTER again, the printout on the video screen would be:

```
SPACE, THE, WORDS, OUT
```

As it is written, the effect is quite different, as you will see. The commas have commanded the computer to space the four words across the width of the screen. Each comma instructs the computer to start printing the next word at the next print zone. There are four print zones, each of which can take up to sixteen characters (letters, numbers or spaces). If you PRINT more than sixteen characters in a zone, the comma causes a skip to the next zone. Try the following program.

```
10 PRINT“SEE THE EFFECT”;  
20 PRINT“OF A SEMICOLON”;  
30 PRINT“ON THE PRINTOUT”
```

Example 1

```
10 PRINT “SPACE”TAB(POS(0)+5)“THE”TAB  
(POS(0)+5)“WORDS”TAB(POS(0)+5)  
“EVENLY”
```

Example 2

```
10 CLS  
20 PRINT TAB(28)“HEADING”  
30 PRINT  
40 PRINT TAB(5)“THIS IS A  
NEATER WAY OF PRINTING”
```

Example 3

The comma is used as a print delimiter. We can also use the semicolon as a delimiter, but with a very different action. Try entering the program in Example 1. With more than one line of program, you must remember to push ENTER at the end of each typed program line. When you run the program (type RUN and hit ENTER), what happens?

The semicolon is another signal to the computer when it's used in this way. Typed after a printed quantity, the semicolon means: use the same line and keep printing, so that the words we typed in three separate instruction lines end up on one single line of type. This would happen, incidentally, even if we had several other lines of instructions between these PRINT instructions, so watch carefully for these semicolons if you are entering a program which has been written in BASIC by someone else. All small computers use this form of instruction.

What happens if you leave out the semicolons? Try it! Each PRINT command causes the video to start on a new line. This is one way you can space out your printing vertically.

Meanwhile, look at Example 2 for a very powerful command which few small computers have in their BASIC. It's the POS function. POS means position, and it means the position of the cursor mark, that short line which shows where the next letter will appear on the screen when you type a program line.

As a result of the POS instruction, the computer makes a note of how far along a line you have printed. Add five to that place number, as we've done in Example 2 and the result is five spaces between each word.

When you type line 10, by the way, don't hit ENTER until the end of the instruction after the last set of quote marks. If you hit ENTER before then, you're indicating that you want to start another numbered instruction line. The other point is that you should type DELETE 20-30, and hit ENTER before running the program. If you don't, you'll print the words in lines 20 and 30 of the previous program, unless, of course, you have switched off between working Examples 1 and 2.

By this time, your video screen must be look-

ing a bit cluttered, so let's look at another useful function that helps clear things up. Example 3 shows a four-line program (we're getting more adventurous) which makes your video printouts look better. The new instruction, CLS, means, simply, clear the screen.

When the program is run, the screen clears, removing the program lines. After the CLS instruction has been used, the next PRINT instruction will place the words in quote marks on the top line.

In line 30, I've used the word PRINT by itself. What does that do? Try leaving it out by typing DELETE 30 and hitting ENTER. Then type RUN and hit ENTER again. See the difference? The PRINT command in line 30 causes a one-line space between HEADING and the words in line 40. Want a two-line space? Then type 30 PRINT, hit ENTER, type 40 PRINT and hit ENTER again. Now run this one and watch the larger gap appear between the heading and the line of words.

Time to take a look at the program. Type LIST and hit ENTER. Your program appears under the last lot of printing, with the lines in correct order. That's just one example of why the BASIC language uses these line numbers. We can place any line number against a line, and the computer sorts them into order. If we use the same number for two different lines, then the last one typed and entered wins, the older one is deleted. We can also delete lines by typing DELETE, then the line number and hitting ENTER.

Can we delete more than one line at a time? Sure we can. Just type DELETE 10-40, and every line of the program in Example 3 will be rubbed out. The other way we can remove a whole program, but this time without needing to know how many lines it has or what their numbers are, is to type NEW and then hit ENTER.

More Spaces

Suppose we want to print a word at the center of the screen. There are sixteen lines of print on a full screen, so we could print on line eight. We could type seven lines with PRINT, but no words, to make the print position move down one line at a time. We could then use the commands PRINT TAB() to space the word to the center of line eight.

There's a much easier way of doing this sort of thing with a TRS-80, by using the PRINT@ command. It must be entered correctly, with no space between the T of PRINT and the @ sign, and a comma immediately after the @. If you put an unwanted space in, you'll get the SN error message when you try to run it. A much less obvious error is typing @ with the SHIFT key depressed. If you hit SHIFT and @ at the same time, the @ appears as usual on the video screen, but the code number which is fed into the computer is NOT the correct one. You'll get the SN error report when you try to run it, but the line will look good on the screen.

With these warnings in mind, try the program in Example 4. Remove the previous programs by typing NEW and entering. Now type in the three lines of the new program and run it. Interesting? The word GREETINGS appears around the center of the screen, and the next

line of print is four lines under that.

Take a look at page E1 at the back of your Level II manual. Turn the page so that the numbers are all correct way up, and you can read off the PRINT@ numbers and the TAB numbers. The numbers in heavy type at the top are the TAB numbers for each line, and also the PRINT@ numbers for the first line, the top line. For the second line of PRINT@ the numbers start at 64 (see the columns down the left and right-hand sides), for the third line, 128, and so on.

To find a PRINT@ starting number for any position on the screen, pick your spot, locate the TAB number at the top of the page and the PRINT@ number for the start (at the left or right-hand side), then add the two. For example, if you want to start around the center, try TAB(31) on the line starting at 448. That gives us a PRINT@ on the number $448 + 31 = 479$, so we type PRINT@479, then add the quote marks and the message. Remember the syntax: PRINT, no space, @, no space, comma, then quote marks for the message, and keep your fingers off that shift key when you are typing the @.

Using More

The TRS-80's big, big BASIC allows us yet another way of printing which isn't available to people with other types of machines. The new instruction this time is PRINT USING, and it instructs the computer to arrange the printing to suit some definite pattern which must be specified in the PRINT USING command. PRINT USING is most useful when you have to print out a number in standard form, such as a price or a sum on a check. It's also useful when you want to round off a fraction.

Since the number of times you are likely to want to use this command in your own programs is limited, compared to the everyday ones such as TAB and PRINT@, we'll look at only a few of the PRINT USING commands.

Example 5 shows PRINT USING applied to rounding off a fraction. Enter the program and run it to see how the number is printed. This is a smart way of making sure that your printout doesn't contain lots of figures after the decimal point. After all, you wouldn't like to think that you had just printed a check for \$56.2357.

Another useful feature of the PRINT USING command is that it can insert a floating dollar sign. Now, if you thought that the dollar was sinking rather than floating these days, let me explain that phrase. You might want to print out something like amounts of \$1.50, \$26.40, \$147.50 and so on. What the floating dollar sign does is position itself ahead of the first figure of the number, so that you don't print \$127.50 and \$02.40. Try it out with the program in Example 6.

The Level II manual has a large number of examples of PRINT USING, so we'll leave this one, which is a more specialized command than most of the ones we shall be using in this series.

Bug BBreak

Depending on the age of your 80, you may already have met the dreaded kkeybbounce. You type PRINT, and it appears on the video screen as PPRINT or PRIINT or some other

```
10 CLS
20 PRINT@475,"GREETINGS"
30 PRINT@704,"THIS USES THE PRINT@
  COMMAND TO SPACE LINES"
```

Example 4

```
10 CLS
20 PRINT USING "###.##";21.471
```

Example 5

```
10 CLS
20 PRINT USING "##.##";2.736
```

Example 6


```

1 POKE 16553,255:FOR N=16480 TO 16492:READ K:POKE N,K:NEXT:FOR N=16435 TO 16
437:READ K:POKE N,K:NEXT:POKE 16405,0:DELETE 1-2
2 DATA 205,227,3,183,200,14,40,16,254,13,32,251,201,195,96,64

```

Listing 1

weird combination of repeated letters.

When you try to run a program with an unwanted double letter in a command word, you'll get a SN error message, meaning that the internal circuits of your computer simply don't recognize the word. Of course, if you have an unwanted double letter in a message which is enclosed in quote marks, then it will simply be printed out that way.

Keybounce is a problem that plagues any mechanical switch, like keyboard switches. You press a key, and the electrical contacts close. But, because they're made from springy material, they bounce open again before finally closing and staying closed. Each time the switch closes, it completes an electrical connection, and if that happens to be the electrical connection which prints the letter P on the video screen, then you get two of them.

Every manufacturer of computers gets around this by using a time delay each time a key is pressed. The computer takes no notice of the key until the time delay is over. Only a small time delay of about a thousandth of one second (one millisecond) is needed.

Radio Shack seems to have given short measure to this problem on the older TRS-80s. On some models, keybounce can be fixed by

pulling off the keycaps and cleaning the contacts. That's what Radio Shack says, anyway, but my own TRS-80 has fixed keycaps that don't come off easily, and it bounces very badly. The keybounce is so bad, in fact, that if there were no cure for it, I would have scrapped the whole thing months ago.

Yes, there is a cure, and it works. Radio Shack supplies a program on a machine code tape entitled KBFIX. Enter this one, and your keybounce troubles are over until the next time you switch on. Incidentally, more recent TRS-80s have no trace of keybounce.

Sometimes keybounce is just a nuisance. Other times it can cause a complete hangup of your computer, and one of these other times is when you type LIST and get LLIST. LLIST is a command word which was unfortunately chosen for printing a list on the Radio Shack line printer. Run LLIST and the result is—nothing. No keys have any effect, nothing appears on the screen, and the computer appears to have died on you, with just that accusing word LLIST staring at you from the screen.

What's happened is that you have commanded the computer to print a list on the printer, and because there's no printer connected, it's

waiting for you to connect one. Don't rush out with a fistful of dollars, because you can recover from this stall in two ways.

One is to switch off completely, but that way you'll lose any program you had in the computer. The easier way is to push the RESET button at the back of the computer, at the opposite end from the ON/OFF switch. On my 80, this is under a small flap which also houses the connector for expanding memory. Pushing and releasing this switch removes the hangup, and the computer is ready to run again. Whatever your manual says, you don't lose your BASIC program when you use RESET unless the Radio Shack expansion interface is connected.

The keybounce problem can also be avoided by using a short BASIC program, shown in Listing 1. It's a sight longer than the others we've used in this part, and you have to be sure that you've typed each character correctly. Run it, and it sorts out the keybounce and then deletes itself!

At this stage, it's not easy to explain how it works, because it makes use of parts of memory we don't normally use, the reserved RAM. The purpose of these memory parts is kept a close secret, and it's only when someone with a bit of time to spare investigates them that we even get to know about them.

Keybounce is just one example of what folks in the computing business call a bug—a flaw in a system. A bug may be in the operating system, or it may be in a program. Wherever it is, these articles will show you how to stamp out some of the most active bugs. ■

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Blow by blow accounts.

A Bout with the I.R.S.

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In one corner, weighing 29 pounds, in black with gray trim, we have the \$750 Radio Shack TRS-80 Level II 16K Microcomputer. In the other corner, weighing *tons*, in red, white and blue, we have the multi-million dollar IRS worldwide computer network. Come out fighting, and may the better machine win!

Round 1: Getting it together

It wasn't a referee who introduced me to the IRS. It was a plain brown envelope advising me of an office audit appointment and detailing the items I should bring. Needless to say, that bit of mail destroyed my day—and most of the next few weeks!

I have had a small business with no employees for 15 years and always wondered when the day of reckoning would come. My tax preparer told me many times that my records were complete and accurate and that I would coast through an audit.

Still, there were always gnawing doubts about whether I could provide satisfactory verification for various expenses. Like everyone, I had heard IRS audit horror stories, and my impression was that no one comes through unscathed. Furthermore, I assumed the auditor would be nasty, intimidating and threatening.

The audit was for 1977. In the three-year interim, we had moved and still had not unpacked cardboard boxes with business records going back 15 years! To further complicate the picture, my wife, Ev, had her own retail business before we married in 1977, so we had filed a joint return, with separate Schedule C's for each business.

The auditor's letter specified that we furnish,

to my surprise, not only our business records and checking account statements, but all personal checking account statements and checks and *all* savings account passbooks!

Yes, *all*! That meant *every* statement and savings passbook from December 1976 to January 1978!

For many people this might only amount to a few accounts, but for Ev and me this meant eight checking accounts and four savings accounts that showed activity in that time period. It took considerable time and effort to get everything together, especially since Ev had closed her business at a considerable loss (that's what triggered the audit!) and delegated, in disgust, a lot of records to the round file!

Finally it looked like we were ready to face the almost infinite resources behind the IRS paper tiger.

Round 2: The \$45,000 Punch

The auditor, Edward, was very congenial, as he led us to his cubical on the third floor of the imposing local Federal Building. Edward spent the first half-hour or so interviewing us about our individual businesses and establishing background information.

"Any inheritances received in 1977? Gifts? How much cash do you keep around the house? Why so many checking and savings accounts? Any loans?"

I suppose if I were cheating, or more paranoid than I had already become, I would have objected to some of the questions as being too personal (practically the only thing he didn't cover was our sex life!)

Instead, I was fascinated by his thoroughness. I did not realize he was slowly but surely peeling away my defenses, preparing for a blow to the solar plexus!

During this time, he was furiously making notes of our replies to his questions. Reading upside down, I saw "T/P claims" in various places. "T/P" means taxpayer.

Asking for our bank statements, he proceed-

ed to list every monthly deposit total on a sheet of lined paper! He did this with *every* bank statement for *every* month in 1977! Then he did the same thing with the savings passbooks, listing *every single deposit* by date!

He used eight sheets of paper and took almost three hours—into his lunch hour—and came up with a grand total of \$141,531.86 deposited in all our accounts in 1977.

Then he checked our 1977 Federal Income Tax Return and added the gross income: \$96,091.

"Mr. Blechman," Edward said, "We have a difference of \$45,440.86 between your deposits and your reported income. Some of this difference may be transfers between accounts or non-reportable income we may not have covered in our initial discussion—loans, social security, gifts, unemployment insurance and so forth. Any of this \$45,000 plus you can't identify and verify will have to be considered non-reported taxable income. Our next appointment is"

The fact that it rained that day, that my raincoat had a big hole in it, and that I lost my rainhat, only added to the feeling that I was down for the count!

Round 3: The Pussycat's Claws

Wondering what I'd look like in stripes and how the food was in Leavenworth, I carefully assessed my situation. I knew we moved money around to pay bills, kept balances equalized and made major purchases through the checking accounts. I had a policy of keeping small balances in the checking accounts, since they earn no interest. Sometimes cash-flow needs required transfers from my savings accounts. But \$45,000 worth of transfers? That much? It didn't seem possible.

I looked for errors in the auditor's figures and couldn't find any. Still over \$45,000 unaccounted for. I felt helpless and overwhelmed, so I picked up my February copy of *80 Microcomputing* to escape and let my subconscious

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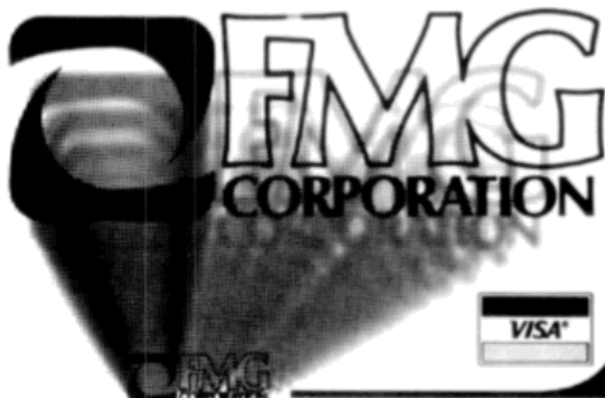
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To add string function to "Household Accountant," change the following program lines:

540	Change	C to C\$
550	Change	-1 to END
950	Change	C to C\$
960	Change	-1 to END
1000	Change	C to C\$
20000	Change	-1 to END

Example 2.

mind look for a solution.

Fate smiled on me, as I turned to page 114 and saw David C. Andreasen's "Household Accountant" with the kicker "Keep track of how much, to whom and when—up to 32,767 accounts."

Well, I didn't have *that* many accounts, so I looked closer. I got excited—this could do it. This could sort out and add transfers between accounts!

I sprang into action. I keyed the program on page 116 into my 16K Level II TRS-80 pussycat. She almost purred as I ran and tested the program, using dummy DATA. It worked!

Then, I realized, I was limited to check number entries only, so I made a few program changes (Example 1) to accommodate strings (loan, cash, etc.).

I started with one checking account and entered each check that transferred money to another account. I assigned a category number to each "path" (Bank one to Bank two was category one, Bank one to Savings one was category two, and so on). I ended up with 18 different paths, or categories, between accounts!

I made some additional changes to the program (Example 2) to accommodate my printer. The program added and printed the totals for all categories, for each month and for the year, listed all transfers individually, printed and added each category—fourteen pages on my printer!

With the help of this program, I was able to account for almost \$43,000 of the \$45,000 plus "unexplained income"!

Round 4: The Technical K.O.

Armed with my computer printouts, plus six cardboard boxes full of records, wheeled in on my dolly, we faced Edward a second time. Once he understood what I was showing him, he was delighted. He said it saved him hours of work!

However, just to make sure I was correct (after all, how can a \$750 computer do anything but play games?), he spent two hours going over the figures, asking me for checks, deposit books, etc., to verify the printout. It was not one penny off! Personal computing had scored a technical knockout!

You may wonder about the other \$2,000 plus that was not accounted for in my analysis. We explained that it was probably garage sale cash and checks deposited in checking accounts, since Ev sold a lot of her furniture and housewares before we got married that year. No problem. You usually sell things at garage sales for less than you paid, so this is usually not taxable income.

Round 5: The Next Match

Forewarned is forearmed! Keep good records. The burden of proof is on the taxpayer, not the IRS. Despite the fantastic help

the "Household Accountant" provided, it is useless without correct data.

Fortunately for me, I have a habit of jotting remarks next to every deposit or withdrawal in my savings passbooks, so I can identify the purpose of each transaction. Without these remarks I doubt if I would have been able to discover a lot of transfers, and that would have been more unreported income on which tax would be due, plus penalty and 12 percent interest for two years!

An auditor told me that the majority of taxpayers end up paying extra taxes as the result of an audit simply because they can't identify, document or verify deductible or non-taxable income.

While an IRS audit is about as pleasant as swimming with a bleeding leg in shark-infested waters, it can be a real challenge and a learning experience. ■

To add printer output for "Household Accountant" add the following program lines:

```
105 CLS:PRINT:INPUT"PRINTER(YES = 1,
NO = 0)";PR
790 IF PR = 1 GOSUB 2000
1025 IF PR = 1 GOSUB 2000
2000 FOR T = 0 TO 15
2010 SS(T) = ""
2020 POKE VARPTR(SS(T)),64
2030 POKE VARPTR(SS(T)) + 1, (T*64 + 15360)
AND 255
2040 POKE VARPTR(SS(T)) + 2, (T*64 + 15360)/
256
2050 NEXT T
2100 FOR T = 0 TO 15:PRINTSS(T):NEXT
2110 RETURN
In line 470, change -1 to END
```

Example 1.

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Pulling Strings Together

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Computers differ from calculators in a number of ways. One of the most significant differences is in the computer's ability to process alphanumeric data (data containing letters, signs and symbols as well as numbers) and to handle "strings."

In computerese, a string is a group of alphanumeric data which is regarded as a single unit. A "prompt line," such as ENTER YOUR NAME, in a program is entered and stored as a string. In a program which must stop to allow manual input of data, the line PRESS ENTER TO CONTINUE might be added to continue execution, after needed data has been typed. Again the line is treated as a string.

A Giant Leap

As with arrays, the distance from Level I to Level II is a giant leap. Level I allows two strings, A\$ and B\$, each of which can be up to 16 characters long. Now we suddenly have hundreds of string locations available, each of which may contain up to 255 characters.

An extensive set of string handling instructions has also become available, allowing us to make some pretty classy moves. We will deal with those instructions in detail in part two. As a beginning we will discuss some basic facts about strings and how computers "recognize" them.

String and non-string data are handled differently by the TRS-80. Because of this difference we must tell the computer how we want information stored. One way to do this is to use a declaration sign in the variable name. In many

dialects of BASIC, the dollar sign is used for this purpose.

With this sign we can use the names A\$, A(1)\$, A1\$ and AA\$, and these variables will all be designated as different string variable names. This is a simple way to indicate string input, if you have only one or two strings, and they will not be referred to very often in the program. An example of this might read:

```
10 D$ = "DISTRICT #1"
```

A second and more efficient method involves the DEFSTR instruction. Inserting the line 10 DEFSTR A-D at the beginning of a program causes the computer to automatically regard any variable starting with A, B, C or D as a string variable, and the dollar sign may be omitted. Combinations such as B(1), DW, A7 or single letters such as C are now valid string locations.

Using these methods makes getting strings into and out of the computer quite easy. We can simply put the string into a program line, such as 10 A\$ = "JANUARY". Note that the data must be enclosed in quotation marks. If you omit the quotes, when the RUN starts the computer responds with a ?TM (type mismatch) error message. Even though the dollar sign is there, the computer does not "see" the word JANUARY as proper input. We must remember that a computer uses complex procedures to convert those letters into numbers, after which it proceeds with operations.

Strings may also be entered using the INPUT instruction. Very often this is done with a prompt line, such as: 10 INPUT "ENTER MONTH";A\$. Inputting strings this way does not require quotation marks, *unless* the string contains commas, colons or leading spaces. If any of these conditions exist, quotes must be used.

When you enter a lot of string information,

perhaps the best method is to utilize the READ and DATA pair. The line, 10 READ A1\$: DATA JANUARY" loads the name of the month into string location A1\$. Once again, quotes must be used if commas, colons or leading spaces are part of the string.

The following lines illustrate three ways of loading strings:

```
10 A$ = "JANUARY"
20 INPUT "ENTER SECOND MONTH";B$
30 READ C$
40 DATA MARCH
50 PRINT,A$,B$,C$
```

Line 10 loads the string manually through insertion in a program line, line 20 by using the INPUT instruction, and lines 30 and 40 by using the READ/DATA pair. Output is shown in line 50. The comma after the PRINT instruction places the three strings in zones two, three and four on the monitor screen.

Loading large numbers of strings may be done quickly and efficiently by using the READ/DATA instructions along with a FOR-NEXT loop. The following lines load the days of the week into an array:

```
10 DEFSTR N
20 FOR A = 1 TO 7
30 READ N(A)
40 NEXT
50 DATA SUNDAY,MONDAY,TUESDAY,
  WEDNESDAY,THURSDAY,FRIDAY,
  SATURDAY
```

The commas in line 50 separate the data into individual "portions" which are picked up in order as the loop cycles. As each portion is stored, the computer marks it off so that it will not be used again without a RESTORE statement. When the loop finishes, the word SUNDAY will be stored in N(1), MONDAY in N(2), etc. through SATURDAY in N(7). Outputting these strings is also accomplished with a loop. Add the following lines and RUN them:

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```
60 CLS:FOR A=1 TO 7
70 PRINT N(A)
80 NEXT
```

String Handling

Now that we have had a look at inputting and outputting strings, we can stop to discuss some idiosyncracies of string handling. Earlier, I mentioned that string and non-string data are handled differently. What is this all about? As a visual aid to our discussion of "string literals," enter and RUN the following lines:

```
10 A = 5
20 AS = "5"
30 PRINT A + A
40 PRINT AS + AS
```

Hmmmm. I'm pretty certain that $5 + 5 = 10$, but look what line 40 has produced! What happened? When a number is introduced into a string it is thereafter regarded as a *symbol* and not as a *value*. No computation may be done with that number as it exists in memory. You may recall the figure 5, but not the value 5. Level II does give us a way to get around this problem and it will be dealt with later.

Line 40 illustrates an operation called "concatenation," a fancy word for joining or linking strings together. In line 30, the computer took the value 5, added it to the value 5 and returned the value 10. Line 40, however, took the symbol 5 and linked it with the symbol 5 to produce a new string which reads 55. We could change line 40 to read: $BS = AS + AS$ and the new string (55) would then be stored in BS.

This brings us back to the string/non-string matter. You will recall that we could not load $AS = "JANUARY"$ without using quote marks. Trying to load $A = "5"$ results in the same mismatch error message. The dollar sign and quote marks *must* be used in conjunction with each other.

In the JANUARY case we had specified a string location by using a dollar sign with A. The quotes said, in effect, "We contain the string to be stored, *not the values*." The quotes around the 5 say the same thing, but using A without the dollar sign indicates that the location is set aside for a value and not a string, so the line is rejected. The computer *does not* know the difference; you must tell it. We must be constantly aware that string data cannot be loaded into a non-string location and vice versa.

String operation is also quirky about spaces. Enter and RUN the following lines:

```
10 READ AS,BS,CS
20 DATA JANUARY, FEBRUARY, MARCH
30 PRINT AS;BS;CS
```

Hey wait a minute! I put semicolons in line 30 like I was supposed to for spaces between the words. Why are they all run together? When using strings, the computer neither assumes nor furnishes spaces, unless you put them in. There are good reasons for this. As an example, enter and RUN these lines:

```
10 AS = "GROSS RECEIPTS FOR 1979 ARE $"
20 INPUT "ENTER GROSS RECEIPTS FOR 1979":R
30 PRINT AS;R
```

Why is there a space between the dollar sign and the amount? I didn't want it there. How can I get rid of it? When the TRS-80 prints a number, it allows a space for the sign of the number. Numbers without signs are assumed to be positive, and we use a sign only if the number is negative.

The computer follows the same rules. Our unwanted space was provided for a sign that we didn't need. To get rid of it, edit lines 20 and 30 to read RS instead of R . Now we get the first digit snuggled up to the dollar sign like we wanted. Putting the number in a string eliminates the space for the sign, because the number is now regarded as a *symbol* and not a *value*.

Of course, now we cannot do any computation with the number, but we'll get around to that. By not furnishing spaces, we are allowed more flexibility in building strings. Here is a simple example of the potential acquired by using concatenation and space allotment:

```
10 READ AS,BS,CS,DS,ES,FS
20 DATA TRS-80,COM,PUT,ING
30 PRINT AS+BS+CS+" "+DS+ES+FS
```

Notice the " " in line 30. That space is the only one I wanted in the string.

We are ready to get our JANUARY, FEBRUARY, MARCH problem unraveled. Remember how they were all run together? There are two ways to fix this. The first is to include the spaces as part of the string so that line 20 reads:

```
20 DATA JANUARY, " FEBRUARY", " MARCH"
```

February and March need quotes and not January, because of the leading spaces. An alternate method to handle this, instead of quote marks, is with concatenation. Change line 30 to read:

```
30 PRINT AS+" "+BS+" "+CS
```

We have accomplished the same goal. This short example merely scratches the surface of what can be done with the various string handling instructions and routines furnished by Level II.

No Arguments

There is one last thing that should be cleared up before moving on. The CLEAR instruction has two uses. Used without an argument (with no number following it) it zaps all data out of variable locations and sets all strings to null (erases them).

Used with an argument, as in CLEAR 1000, it still zeros all memory locations containing data, but in addition it sets aside 1000 bytes of space for strings in memory. When the TRS-80 is powered up, it automatically reserves 50 bytes for strings, and if you attempt to enter more than that you will get an ?OS (out of string space) error message.

When you need more than 50 bytes you must reserve such space with the CLEAR(n) instruction, preferably at the very beginning of the program. Should the computer encounter a CLEAR after data has been entered, all such data will be lost. And that can get irritating—fast.

Strings may be tested or compared, just as numbers can in Level II. This makes possible such operations as alphabetizing or searching files for a particular name. This process normally involves using the IF-THEN instruction and what are called the "relational operators." There are six of these operators: equal to, not equal to, greater than, less than, greater than or equal to and less than or equal to.

In string comparisons, these operators work exactly as they do for numerical operations. This brings up an interesting question. We know that the TRS-80 operates on numerical data and that before numbers can be operated on, they must be converted to base 2 or binary numbers. So, how can it tell the difference between A and B or know that the name Brown should come before the name Williams? For an answer we must digress for a moment and take a quick look at what are called the ASCII codes.

The letters ASCII stand for American Standard Code for Information Interchange. Looking at pages C/1 and C/2 of your Level II manual, you see that certain control operations (page C/1) and all signs, symbols, letters and digits (page C/2) are assigned a code number. The dollar sign, for instance, is assigned code # 36, uppercase letters numbers 65 through 90, lowercase letters numbers 96 through 127, digits 0 through 9 numbers 48 through 57, and the graphics characters numbers 129 through 191.

These code numbers were assigned to assist in transferring information between various pieces of equipment, but they also carry some fringe benefits. The computer cannot tell the difference between G and M, but it can differentiate between 71 and 77. The ASCII code numbers are compared when working with alphanumeric information.

To compare the letters G and M for alphabetical precedence, the BASIC language looks at the ASCII codes and not the letters themselves. Since the letters' codes are in ascending numerical order it simply finds the lower number. The computer then sends, on the basis of some test, execution to a specified location or address.

If the strings to be compared contain more than one character each, the computer begins by comparing the first character in the strings, then the second, third and so on, until a match is either found or not. By using multiple IF-THEN tests, very intricate directions can be given; for example, if the first letter precedes the second, go to location A, if the letters are the same, go to location B, and if the second precedes the first, go to location C. Let me stress that strings must be *identical* to be

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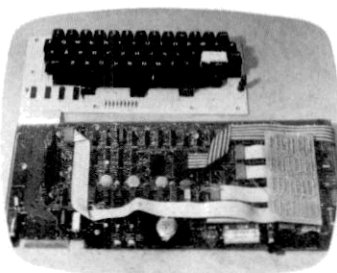
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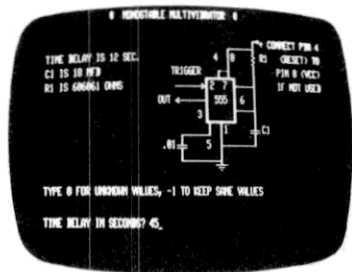
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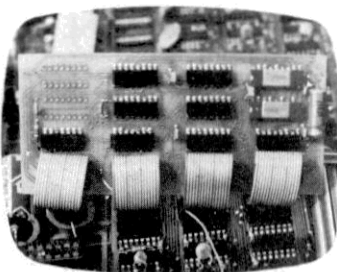
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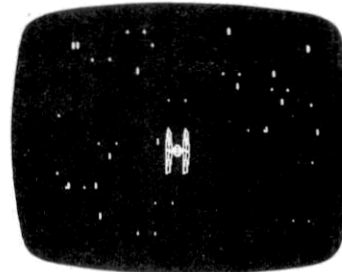
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```

10 DEFSTR A,B:DEFINT I,J
20 FOR J=1 TO 7:READ A(J):NEXT
30 DATA B,E,A,D,G,C,F
40 F=0
50 FOR I=1 TO 6
60 IF A(I) <= A(I+1) THEN 90
70 B=A(I):A(I)=A(I+1):A(I+1)=B
80 F=1
90 NEXT
100 IF F=1 THEN 40
110 CLS:PRINT"HERE ARE THE LETTERS
    IN ORDER:"
120 FOR I=1 TO 7:PRINT A(I)+" ";:NE
    XT

```

Listing 1

matched, down to the last space or period. In a long string one character can prevent a match-up.

Applications

Program Listing 1 illustrates a very simple sort routine that takes seven letters and alphabetizes them. In computer jargon a sort is a program which can put data into some specified order. There are numerous sorting routines, including Shell sorts, bubble sorts, ripple sorts, quicksorts and binary search sorts. All depend on string comparisons and branch instructions.

Line 10 of the routine designates A and B as string locations and I and J as integer locations. Sorts run a little faster if the loop counters are defined as integers, as this eliminates some of the computation necessary for single precision numbers. Lines 20 and 30 read data into the computer using an array loop.

Lines 40 and 80 have to do with setting and resetting a flag in the variable location F. This flag defines an escape route from the loop when all of the data is in alphabetical order.

The heart of the program is the loop in lines 50 through 90. After the flag is set to zero in line

40, line 50 establishes the loop and sets I to 1. Line 60 compares the letter in A(1) with the letter in A(2). Remember, the letters are not being compared, but rather their ASCII numbers. If the letters are in the right order, execution branches to line 90, then to line 50, which increments I by one and then tests to see if the letters in A(2) and A(3) are in the right order.

If all of the letters had been in the right order originally, this process would continue until I had been incremented to seven, dropping execution to line 100. Since the flag is still set at zero, the test fails, and lines 110 and 120 are executed to print the results.

If, however, line 60 uncovers two letters which are not in order, execution proceeds to line 70. Let's say that the letters in A(3) and A(4) were not in proper order. The computer then puts the letter in A(3) into a temporary location named B, transfers the letter in A(4) to A(3), and then puts the original letter which is stored in B into A(4). The two letters are now reversed in position. The letter which was in A(3) is still in B, but will either be written over or ignored.

After line 70 has completed the exchange, line 80 sets the flag to 1, and line 90 returns execution to line 50, which increments I and starts the loop cycling again. The I in location F told the computer that a change had been made and that it was not finished. This continues until all letters are in order, at which time line 60 sends execution to line 90, until the loop completes and line 100 sends execution to line 40, resetting the flag.

On the next pass the computer escapes to lines 110 and 120 for printout. One of the disadvantages of this routine is operating time. With only seven letters it loads, sorts, and prints out rather quickly. It takes more time relative to the elements increasing in number and/or complexity.

The ability to compare strings is very handy in locating a particular name or file stored in an array. Program Listing 2 shows an elementary example. Line 10 defines variables by type. Lines 20 to 40 load five names into an array named N. Line 60 allows you to enter the name to be found and stores that name into location A(\$). Lines 70 through 90 set up a loop and compare what is in A to each member of the arrays. If it cannot find the name, line 100 sets up a default instruction and returns you to line 60 for another try. If the name is found in line 80, execution branches to line 110 to return the file number. Any other information that was in that file could, of course, be retrieved at this point.

Try adapting or changing these routines to accomplish a specific task. A good exercise is to combine Listing 1 with Listing 2 to allow you to enter names in any order. Then have the computer alphabetize them and search for a particular name. As you gain fluency in handling strings, you will be amazed at what this little machine can do. ■

```

10 DEFINT I:DEFSTR A,N
20 FOR I=1 TO 5
30 READ N(I)
40 DATA BROWN T.,CARVER J.,FRANK J.,
    MILLER J.,WILLIAMS B.
50 NEXT
60 INPUT"ENTER NAME YOU WANT FOUND"
    :A
70 FOR I=1 TO 5
80 IF A=N(I) THEN 110
90 NEXT
100 CLS:PRINT"THE NAME YOU SPECIFIED
    IS NOT LISTED":GOTO 60
110 CLS:PRINT"THE NAME YOU SPECIFIED
    IS IN FILE #":I

```

Listing 2

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TELETYPE	06/25/79	10:00	TELETYPE	10	4.00	40.00
TELETYPE	06/25/79	10:00	TELETYPE	10	4.00	40.00
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This also means that this utility program must be executed immediately after it has been loaded and can be used only once per load.

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When the tape has loaded, its execution follows directly. There is no prompt for a / or entry point.

The program offers one user option: Remarks may be retained or deleted. Before the program executes, a prompt is

displayed and the option is selected. For purposes of debugging or documentation, it may be desirable to retain remarks; in some programs a remark may be the target of a GOTO or a GOSUB.

Upon completion, the number of bytes deleted from the BASIC program will be displayed at the upper left of the screen.

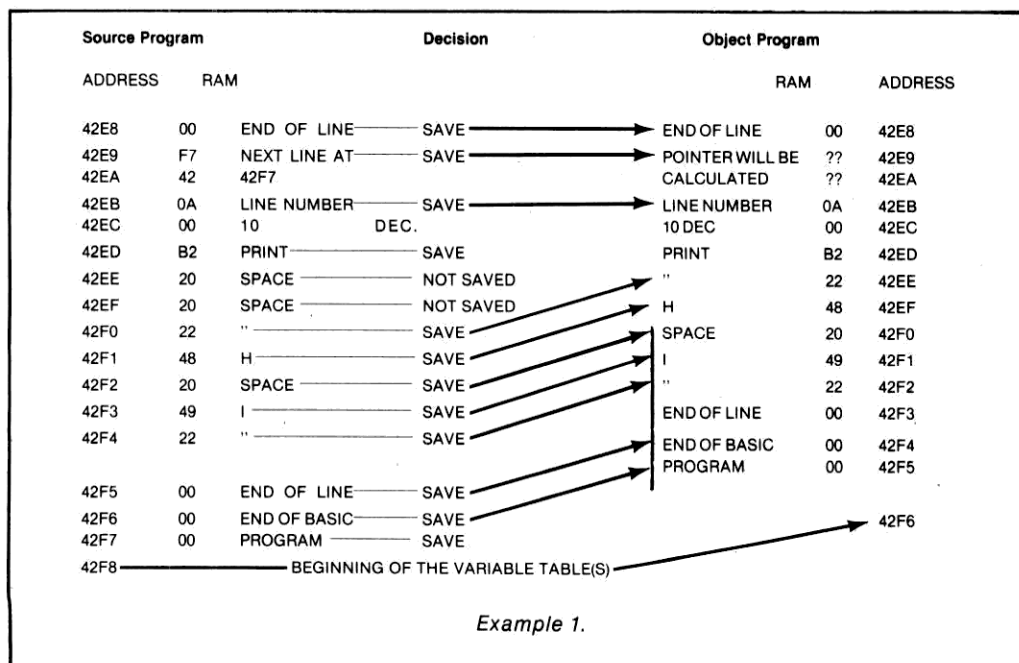
The discussion has been directed toward a Level II system. But it applies as well to a disk-based system, with the exception that there are other areas of RAM available in disk systems.

BASIC

Basic Commands are stored in RAM as one-byte tokens. When a BASIC program line is keyed, it is first written in the input buffer. Then, routines in ROM rewrite the line, substituting one-byte tokens for each reserved word found. Numbers 80H and above are used. These will be greater than the ASCII character set, and when the BASIC interpreter encounters a number in this range, it knows that it has found a command.

The end of line marker is 0. Zeros never appear in the text. When the interpreter encounters 0, it knows it has reached the end of the line. (A 0 may, however, be part of a line number or line pointer.)

While you can find the end of the current line by advancing until 0 is encountered, you cannot back up to find the end of the previous line as the 0 encountered could be part of a line num-



ber or pointer.

The first two bytes of a line point to the address of the next line. The next two bytes of the line are the number of the line. A line pointer of 0000 indicates the end of the BASIC program.

The Z-80 stores two-byte numbers, least significant byte first. 40A4 would appear in RAM, or in the assembler program listing, as A4 40. All bytes which have no program function will be deleted. The BASIC program is altered as described in the following text.

Formatting Commands

Any byte in the range 1 to 32 decimal is deleted. These are usually a space (ASCII 32) or a line feed (ASCII 10, entered from the keyboard or by the down arrow). The tab (right arrow), entered when the line is initially keyed, also writes spaces (ASCII 32s) in the line which will be deleted.

Formatting bytes preceded by a DATA token or a comma will be deleted, not saved. All other bytes will be unaffected, or protected.

Remarks can be deleted or saved depending upon user option. The remark begins with the REM or ' command and preced-

ing bytes may be deleted.

There are some special cases. A legal BASIC line with no text will be deleted. For example: 100 :. This would be accepted by BASIC, but does nothing. Superfluous colons will also be deleted, as in the example below:

```
100 FOR I = 1 TO 6:
```

How it Works

The original BASIC program is treated as a source program and is used to write an object program. Each source byte is examined and is either saved or not saved in the object program.

HL is the source program pointer for the byte of the source program which is being examined. DE is the object program pointer that points to the location where the next byte of the object program will be written.

A byte is saved by writing it in the address indicated by the object program pointer and incrementing both the source and object program pointers. A byte is deleted by incrementing the source pointer without writing the byte to the object program.

The BASIC source program,

10 PRINT "H I", produces the object program. Example 1 illustrates the pointers.

The main program is controlled by TEXT. TEXT sets itself as the return address by pushing its address into the stack. On RET, the top of the stack is popped into the Z-80 program

counter. This allows the program to be arranged into small callable blocks and it always returns control to the same point after whatever branching takes place.

TEXT then checks for the cases which will be handled by special processing routines: the end of the source program line

BASIC PROGRAM	APPEARS IN RAM AS
REM	93
:	3C 93 FB
10 :	0A 00 3C 3C 93 FB
10 :	0A 00 3C 93 FB
15360 REM	00 3C 93
15360 :	00 3C 3C 93 FB
15360 :	00 3C 3C 3C 93 FB
15538 REM	B2 3C 93
PRINT:REM	B2 3C 93
PRINT:	B2 3C 3C 93 FB

Table 1.

AUTO	Auto execute
START	Start the program
DISPR	Display prompt
DISSTR	Display string (pointed to by HL)
SCAN	Scan the keyboard
REMOPT	Remark option chosen (save remarks)
NOREM	No remarks to be saved
TEXT	Text of BASIC line
SAVE	Save byte in Object Program
NOSAVE	Do not save byte in Object Program
ENDLINE	End of the line (in Source Program)
NOTEND	Not the end of the BASIC program
FIRST	First byte of the text
BEGSMT	Beginning of the BASIC statement
EXITSP	Exit the SPACE program (sorry!)
QUOTE	Quote found in Source Program
REMDL	Remarks to be deleted
REMSAV	Remarks to be saved
DATA	DATA statement found in BASIC program
PROMPT	Prompt

Table 2. Assembler Mnemonics and Derivations.

```
1 "
    THIS IS A TEST  FOR THE UTILITY PROGRAM 'SPACE'
"
10 PRINT  "H E L L O": H E L L O
20 PRINT  "HELLO : GOOD-BYE
30 DATA 1, 2, 3:DATA 1, 2, 3
40 DATA 1, 2, 3, ":":DATA "T E S T": T E S T
50 REM TEST
60 'TEST
70 'TEST
80 A:'TEST
90 B: 'TEST
100 AA:'TEST
110 BB: 'TEST
120 :
130 :
140 A:REM TEST
150 B: REM TEST
160 AA:REM TEST
170 BB: REM TEST
180 DATA MONDAY,TUESDAY, WEDNESDAY,
    THURSDAY, FRIDAY, SATURDAY,
    SUNDAY
190 X$="
    MONDAY
    TUESDAY
    WEDNESDAY
    THURSDAY
    FRIDAY
    SATURDAY
    SUNDAY"
15360 : 'TEST
20000 END
```

Source program.

```
1 "
    THIS IS A TEST  FOR THE UTILITY PROGRAM 'SPACE'
"
10 PRINT"H E L L O":HELLO
20 PRINT"HELLO : GOOD-BYE
30 DATA1,2,3:DATA1,2,3
40 DATA1,2,3,":":DATA"T E S T":TEST
80 A
90 B
100 AA
110 BB
140 A
150 B
160 AA
170 BB
180 DATAMONDAY,TUESDAY,WEDNESDAY,THURSDAY,FRIDAY,SAT
    URDAY,SUNDAY
190 X$="
    MONDAY
    TUESDAY
    WEDNESDAY
    THURSDAY
    FRIDAY
    SATURDAY
    SUNDAY"
20000 END
```

Object program.

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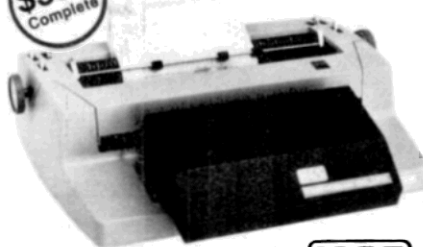
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or a quote. If neither is encountered, a check is made for a formatting command.

If the byte is a formatting command, there is a jump to NOSAVE in the object program. If the byte is not, it is considered necessary to the BASIC program and is saved.

RET returns to TEXT to begin the process all over again for the next byte. Note that SAVE and NOSAVE also update the pointers, return the source byte in the

accumulator and set the Z flag if the end of the source line has been reached.

Endline

This module is entered if the end of the source line has been reached. On entry A=0; HL points to the end of the source line; and DE points to the address where the end of the object program line will be written.

A check is also made to determine if this is also the end of the

BASIC program. If this is the case, a jump is made to the exit routine, EXITSP.

In the first byte of a statement a number of unique situations may occur. These are treated as special cases and handled by BEGSMT. A check is made for DATA and REMARK commands, which occur only at the beginning of a statement. Also, a statement may have no text, as mentioned earlier. In this case, it is treated as a remark and is deleted by the remark delete routine. Extra colons may have been entered through user error or keyboard bounce and are not saved. A RET is used again to return to TEXT.

Remarks present a problem. Processing remarks is made complicated by the fact that there are two different remark formats. REM is stored in RAM as 93H (REM token). ":" is stored in RAM as 3C 93 FB (: REM FB). The colon may also indicate the end of a statement which in turn may precede a REM token.

Things are further compli-

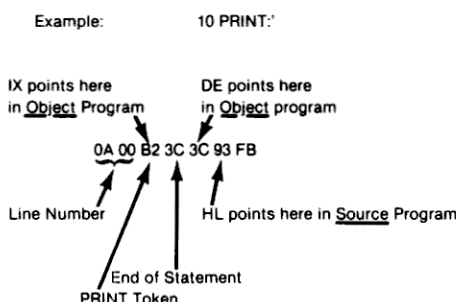
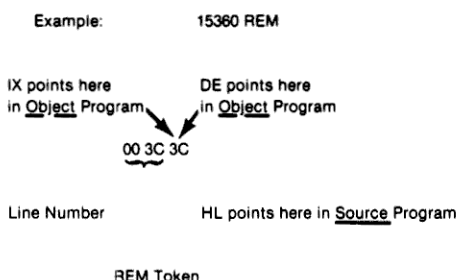
cated by the need to know whether the remark is at the beginning of a line or at the beginning of a statement in a multiple statement line. Once all this has been figured out, the source and object program pointers are adjusted accordingly. Table 1 shows several example remarks as they appear in RAM.

Table 1 also shows the problems of backing up. One solution is to save the address of the first byte of the object text in register pair IX. If, on entry to the remark processing routine, DE=IX, then the remark processing routine, DE=IX, then the remark is at the beginning of the line. If DE is not equal to IX, then the remark is in a statement in a multiple statement line. Note that the colons as the first character of the text will not be saved. Example 2 shows remarks with pointers.

In addition to containing the display message SAVE REMARKS Y/N ?, the prompt string contains a number of ASCII control codes. When the prompt is

EXAMPLES OF REMARKS WITH POINTERS

On entry to the remark processing routine, the pointers will be as follows:



Example 2. Remarks with pointers

```

42D1 53 S 15600 DEFM 'SAVE REMARKS Y/N ?'
42D2 41 A
42D3 56 V
42D4 45 E
42D5 20
42D6 52 R
42D7 45 E
42D8 4D M
42D9 41 A
42DA 52 R
42DB 4B K
42DC 53 S
42DD 20
42DE 20
42DF 59 Y
42E0 2F /
42E1 4E N
42E1 20
42E3 3F ?
42E4 00 15700 DEFB 0 ;END OF MESSAGE MARKER

00000 TOTAL ERRORS

```

Example 3. Hexadecimal Representation of ASCII Characters.

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Program Listing

```

40A4      00500 BPRPTR EQU 40A4H ;BASIC PROGRAM POINTER
0093      00600 REMTOK EQU 93H ;REMARK TOKEN
0088      00700 DATTOK EQU 88H ;DATA TOKEN
40F9      00800 SCLRPT EQU 40F9H ;POINTER TO VARIABLE TABLE (SCALARS)
0021      00900 FORMAT EQU ' '+1 ;ASCII CONTROL CODE & SPACE, 1 TO 32 DEC.
01C9      01000 CLS EQU 01C9H ;CLS ROUTINE IN ROM
28A7      01100 DISSTR EQU 28A7H ;DISPLAYS STRING AT HL UNTIL BYTE=0
0FAF      01200 DISNUM EQU 0FAFH ;DISPLAYS DECIMAL REPRESENTATION OF NUMBER
          01300
41E2      01400 ORG 41E2H
41E2 C3E641 01500 JP AUTO
          01600
41E6      01700 ORG 41E6H
          01800
41E6 3EC9 01900 AUTO LD A,0C9H ;'RETURN' COMMAND
41E8 32E241 02000 LD (41E2H),A ; TO RAM
41E8 21CB42 02100 DISPR LD HL,PROMPT ;POINT TO MESSAGE
41EE CDA728 02200 CALL DISSTR ;DISPLAY MESSAGE
41G1 CD4900 02300 SCAN CALL 0049H ;SCAN UNTIL KEYBOARD INPUT
41F4 FE4E 02400 CP 'N' ;="N" ?
41F6 2809 02500 JR Z,NOREM ;YES, DELETE REMARKS
41F8 FE59 02600 CP 'Y' ;="Y" ?
41FA 20F5 02700 JR NZ,SCAN ;NO, UNACCEPTABLE INPUT
41FC 3E52 02800 LD A,REMSAV-REMJP-2 ;JR OFFSET
41FE 324742 02900 REMOPT LD (REMJP+1),A ;MODIFY PROGRAM
4201 CDC901 03000 NOREM CALL CLS ;CLEAR SCREEN
4204 2AA440 03100 LD HL,(BPRPTR) ;POINT TO BASIC PROGRAM
4207 2B 03200 DEC HL ;
4208 E5 03300 PUSH HL ;
4209 D1 03400 POP DE ;HL AND DE POINT BEG. PROG. -1
420A AF 03500 XOR A ;SET AS FOR END OF LINE
          03600
420B E5 03700 TEXT PUSH HL ;SET 'TEXT'
420C 210B42 03800 LD HL,TEXT ; AS
420F E3 03900 EX (SP),HL ; RETURN ADDRESS
4210 B7 04000 OR A ;A = 0 ?
4211 2817 04100 JR Z,ENDLINE ;YES, END OF LINE
4213 FE3A 04200 CP ':' ;=":" ?
4215 2005 04300 JR NZ,TEXT1 ;NO, NOT END OF STATEMENT
4217 CD2442 04400 CALL SAVE ;SAVE END OF STATEMENT MARKER
421A 1822 04500 JR BEGSMT ;CHECK FIRST BYTE OF TEXT
421C FE21 04600 TEXT1 CP FORMAT ;SPACE OR LINE FEED ?
421E 3806 04700 JR C,NOSAVE ;YES, DO NOT SAVE
4220 FE22 04800 CP '"' ;QUOTE ?
4222 283F 04900 JR Z,QUOTE ;YES, JUMP TO QUOTE ROUTINE
          05000
4224 12 05100 SAVE LD (DE),A ;BYTE TO OBJECT PROGRAM
4225 13 05200 INC DE ;INC. OBJ. PROG. POINTER
4226 23 05300 NOSAVE INC HL ;INC. SOURCE PROG. POINTER
4227 7E 05400 LD A,(HL) ;SOURCE BYTE TO A
4228 B7 05500 OR A ;RETURNS Z FLAG IF END OF LINE
4229 C9 05600 RET ;RETURN
          05700
422A E5 05800 ENDLINE PUSH HL ;END
422B 23 05900 INC HL ; OF
422C 7E 06000 LD A,(HL) ; BASIC
422D 23 06100 INC HL ; LINE
422E B6 06200 OR (HL) ; ?
422F E1 06300 NOTEND POP HL ;. FIVE BYTES
4230 010500 06400 LD BC,05 ;. TO
4233 EDB0 06500 LDIR ;. OBJECT PROGRAM
4235 281A 06600 JR Z,EXITSP ;END OF PROGRAM, EXIT
4237 D5 06700 PUSH DE ;SAVE ADDRESS OF
4238 DDE1 06800 POP IX ; OBJECT PROG. TEXT
423A 2B 06900 DEC HL ;FUDGE FACTOR
423B CD2642 07000 FIRST CALL NOSAVE ;INC SOURCE PROGRAM POINTER
423E 2849 07100 BEGSMT JR Z,REMDL ;NO TEXT, DELETE LINE
4240 FE3A 07200 CP ':' ;=":" ?
4242 28F7 07300 JR Z,FIRST ;YES, DO NOT SAVE
4244 FE93 07400 CP REMTOK ;IS IT A REMARK ?
4246 2841 07500 REMJP JR Z,REMDL ;YES, JUMP TO REMARK PROCESSING
          ROUTINE
          ;SPACE OR LINE FEED ?
          ;YES, DO NOT SAVE IN OBJ.PROGRAM
          ;DATA STATEMENT ?
          ;YES, JUMP TO PROCESSING ROUTINE
          ;RETURN
4248 FE21 07600 CP FORMAT ;SPACE OR LINE FEED ?
424A 38EF 07700 JR C,FIRST ;YES, DO NOT SAVE IN OBJ.PROGRAM
424C FE88 07800 CP DATTOK ;DATA STATEMENT ?
424E 2859 07900 JR Z,DATA ;YES, JUMP TO PROCESSING ROUTINE
          ;RETURN
4250 C9 08000 RET ;RETURN
          08100
4251 1B 08200 EXITSP DEC DE ;POINT DE TO NEW
4252 1B 08300 DEC DE ; VARIABLE (SCALAR) POINTER
4253 D5 08400 PUSH DE ;SAVE ADDRESS OF NEW SCLRPT
4254 2AF940 08500 LD HL,(SCLRPT) ;OLD POINTER TO HL
4257 ED52 08600 SBC HL,DE ;COMPUTE DIFFERENCE
4259 CDAF0F 08700 CALL DISNUM ;DISPLAY NUMBER
425C CDFE20 08800 CALL 20FEH ;CURSOR TO NEXT LINE
425F E1 08900 POP HL ;NEW POINTER TO HL
4260 C3772C 09000 JP 2C77H ;INITIALIZE FOR BASIC
          09100
4263 CD2442 09200 QUOTE CALL SAVE ;SAVE (OPENING '"' ON ENTRY)
4266 C8 09300 RET Z ;RETURN IF END OF LINE
4267 FE22 09400 CP '"' ;CLOSING '"' ?
4269 20F8 09500 JR NZ,QUOTE ;NO, SAVE BYTE
426B C32442 09600 JP SAVE ;SAVE CLOSING '"'

```

Program continues

printed by routines in BASIC ROM, these are recognized as control codes and the appropriate function is performed.

The first six bytes of the prompt would be duplicated in BASIC by:

```

PRINT CHR$(28);CHR$(31);
PRINT CHR$(13);CHR$(13);CHR$(13);
(or PRINT:PRINT:PRINT)
PRINT TAB(16);

```

The ASCII control codes are described on page C/1 of the *TRS-80 Level II Manual*.

Auto Execute

After the tape has been loaded, control goes directly to the program. The system command calls 42E2. BASIC initializes this as a RET. Using a new ORG, the system tape changes this to a jump to assembler routine AUTO. AUTO restores the return command so that system will not attempt a disastrous jump to this program the next time it is invoked.

For those interested in understanding the program in more depth, the assembler listing is commented and, in addition to the usual flow charts, an "organization" chart has been provided.

The program uses a number of routines in BASIC ROM. For the purposes of this article, they are treated as "black boxes." However, by reading the comments and seeing how they have been used their function and application may be understood.

T-BUG and Space

Although the assembler listing uses multiple origins and the

```

# M 41E2 C9 C3
41E3 00 E6
41E4 00 41
41E5 3A 3A
41E6 B3 3E
41E7 48 C9
41E8 00 32
41E9 19 E2
41EA 80 41
41EB 44 21
41EC C3 CB
41ED 63 42
41EE 0B ETC.....

```

Example 4.


```

09700
09800 ;NEW ORG IF LOADED INTO BUFFER AREA
09900 ;SYSTEM COMMAND USES 4287 TO 428E FOR STACK
10000 ;ON ENTRY TO 'SYSTEM', SP SET TO 4288
10100
4289      10200      ORG      4289H
10300
4289 DDE5      10400 REMDEL  PUSH  IX          ;IX TO HL
428B E3        10500      EX      (SP),HL      ; HL TO STACK
428C DF        10600      RST     18H          ;HL = DE ?
428D E1        10700      POP     HL          ;RESTORE HL
428E 1B        10800      DEC     DE          ;DEC OBJ PROG POINTER
428F 2004      10900      JR      NZ,REM1      ;REM IS NOT AT BEGINNING OF LINE
4291 1B        11000      DEC     DE          ;REM IS AT BEGINNING OF LINE
4292 1B        11100      DEC     DE          ; DEC OBJECT PROG. POINTER
4293 1B        11200      DEC     DE          ; TO END OF
4294 1B        11300      DEC     DE          ; PREVIOUS LINE
4295 AF        11400 REM1   XOR     A          ;COMPARISON BYTE FOR SEARCH
4296 EDB1      11500      CP      R          ;SEARCH
4298 2B        11600      DEC     HL          ;POINT TO END OF LINE
4299 C9        11700      RET
11800
429A 23        11900 REMSAV  INC     HL          ;WHICH
429B 7E        12000      LD      A,(HL)        ; FORM
429C 2B        12100      DEC     HL          ; OF
429D FEFB      12200      CP      0FBH        ; REMARK ?
429F 2001      12300      JR      NZ,REMSA0    ;SIMPLE 'REM', NOT " "
42A1 2B        12400      DEC     HL          ;POINT TO PRECEDING ':'
42A2 7E        12500 REMSA0  LD      A,(HL)        ;BYTE TO A
42A3 CD2442    12600      CALL    SAVE          ;SAVE UNTIL
42A6 20FA      12700      JR      NZ,REMSA0    ; END OF LINE
42A8 C9        12800      RET
12900
42A9 062C      13000 DATA   LD      B,', '      ;SET FOR "OK TO DELETE FORMAT"
42AB CD2442    13100 DATA1  CALL    SAVE          ;SAVE DATA TOKEN
42AE C8        13200 DATA2  RET     Z          ;END OF LINE
42AF FE22      13300      CP      '"'          ; = '"'
42B1 CC6342    13400      CALL    Z,QUOTE        ;YES, PROCESS QUOTE
42B4 B7        13500      OR      A          ;END OF LINE ?
42B5 C8        13600      RET     Z          ;YES, RETURN
42B6 FE3A      13700      CP      ':'          ;END OF STATEMENT ?
42B8 C8        13800      RET     Z          ;YES, RETURN
42B9 FE21      13900      CP      FORMAT        ;SPACE OR LINE FEED ?
42BB 300B      14000      JR      NC,DATA4      ;NO, SAVE BYTE
42BD 78        14100      LD      A,B          ;PREVIOUS OBJECT
42BE FE2C      14200      CP      ','          ; BYTE A ',' ?
42C0 2005      14300      JR      NZ,DATA3      ;NO, SAVE BYTE
42C2 CC2642    14400      CALL    Z,NOSAVE        ;YES, OK TO DELETE
42C5 18E7      14500      JR      DATA2        ;NEXT DATA BYTE
42C7 7E        14600 DATA3  LD      A,(HL)        ;RESTORE CURRENT BYTE
42C8 47        14700 DATA4  LD      B,A          ;SAVE FOR COMPARISON
42C9 18E0      14800      JR      DATA1        ;NEXT BYTE
14900
42CB 1C        15000 PROMPT  DEFB     28          ;HOME CURSOR
42CC 1F        15100      DEFB     31          ;CLEAR TO END OF FRAME
42CD 0D        15200      DEFB     13          ;CURSOR TO NEXT LINE
42CE 0D        15300      DEFB     13
42CF 0D        15400      DEFB     13
42D0 D0        15500      DEFB     208
42D1 53        15600      DEFB     'SAVE REMARKS Y/N ?'
42E4 00        15700      DEFB     0          ;END OF MESSAGE MARKER
15800
0000      15900      END

```

```

AUTO      41E6 01500 00200
BEGSMT    423D 06600 04100
BPRPTR    40A4 00600 02700
CLS       01C9 01100 02600
DATA      42A9 12500 07400
DATA1     42AB 12600 14300
DATA2     42AE 12700 14000
DATA3     42C7 14100 13800
DATA4     42C8 14200 13500
DATTOK    0088 00800 07300
DISNUM    0FAF 01300 08200
DISPR     41EB 01700
DISSTR    28A7 01200 01800
ENDLINE   422A 05400 03700
EXITSP    4250 07700 06100
FIRST     423A 06500 06800 07200
FORMAT     0021 01000 04200 07100 13400
NOREM     4201 02600 02100
NOSAVE    4226 04900 04300 06500 13900
NOTEND    422E 05800
PROMPT    42CB 14500 01700
QUOTE     4262 08700 04500 09000 12900
REM1      4295 10900 10400
REMDL     4289 09900 06600 07000
REMJ      4245 07000 02400 02500
REMOPT    41FE 02500
REMSA0    42A2 12000 11800 12200
REMSAV    429A 11400 02400
REMTOK    0093 00700 06900
SAVE      4224 04700 04000 08700 09100 12100 12600
SCAN      41F1 01900 02300
SCLRPT    40F9 00900 08000
TEXT      4208 03300 03400
TEXT1     421C 04200 03900

```

program lies in noncontiguous memory, it may be entered by T-BUG or another monitor program.

At the time when the byte read from the tape is written into RAM, the stack is at its highest position, and therefore no damage will be done. Bytes will be loaded into the stack area, but will immediately be overwritten by the stack operations of the system load.

The assembler does not print out the ASCII values for DEFM commands. These values are given in Example 3.

After the program has been entered, punch a tape with P 41E2 42E4 0000 SPACE (enter). Any value may be entered for the entry point as it is never used.

If all of this is still a little new to you, compare Example 4 with the assembler listing. This will show how the two relate and how to enter the listing with T-BUG.

Be careful that 41E5 is not changed. The column on the right is the program from the assembler listing. The column in the middle is whatever was in the input buffer.

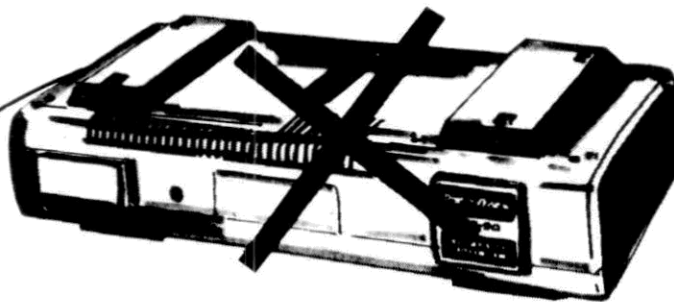
Disk BASIC and Space

This program is intended primarily for the Level II user. It is, however, currently being used with a recently acquired disk operating system with no noticeable ill effects.

However, 41E6 to 42E7 is no longer the input buffer area. I have no idea what it becomes. The buffer may be found by looking in 40A7 and 40A8. These two bytes hold the address of the input buffer.

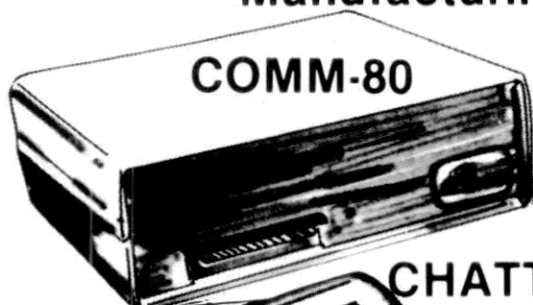
Three bytes of RAM will be changed. In Level II, 41E2 is a RET (c9). In NEWDOS, it is a jump to another address which is a RET. Changing 41E2 to RET, obviously, performs the same function from a different address. This change has yet to cause trouble.

With an input buffer, an overlay area and a number of disk input buffers to play with, other areas of RAM could be called into use for this utility; and, the auto execute feature could be removed. ■



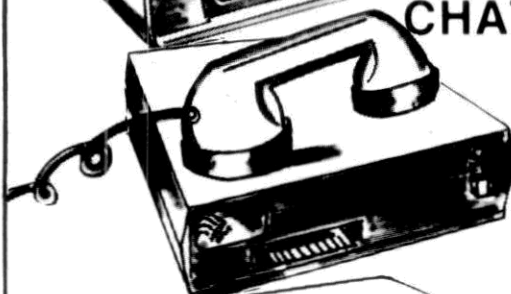
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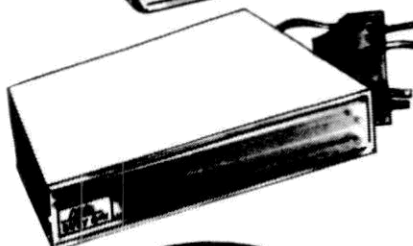


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Single stroke entry of BASIC keywords.

Uni-key

Rowland Archer Jr.
Flint Ridge Apt. 59
Hillsborough, NC 27278

One night while I was trying to massage some life into my tired fingers after a couple of hours at the keyboard, it occurred to me that typing programs is the sort of drudgery a

computer is supposed to take out of life, not put into it. Typing a BASIC program repeats many of the same BASIC keywords over and over again.

To pass some of this work off on the TRS-80, I needed a way to let it know which keyword I wanted with a single-key abbreviation. Using computerized keywords would also cut down on syntax errors and tedious editing.

Lowercase ASCII Code

Even though BASIC is uppercase only on the TRS-80, the keyboard will generate lowercase ASCII character codes. Try this short BASIC program and see what happens:

```
10 CLS:
20 AS = ""
30 AS = INKEY$: IF AS = "" THEN GOTO 30
40 PRINT @0,ASC(AS):: GOTO 20
```

Run the program and press any alphabetic key, say "A." The ASCII code for uppercase A, 65, should appear on the screen. Now press SHIFT A; the code printed should be 97, which is lowercase a.

To get lowercase letters on a TRS-80, you press the SHIFT key. Although it may seem backwards to shift for lowercase, would you rather have to shift for uppercase? You would have to hold down the SHIFT key to enter every BASIC keyword. A SHIFT-lock key would get around this problem, but apparently Radio Shack didn't feel the need for one. This article, however, will relate a software fix.

A routine, which examines every pressed key before the character value is returned to the BASIC interpreter program, is necessary. When the TRS-80 appears to be doing nothing, it is actually reading the keyboard over and over, waiting for a key to be pressed.

Assuming it is possible to intercept characters from the keyboard and look them over before they reach BASIC; then it

is possible to decide whether to send the character on to BASIC as is, send back some other character instead, or even send BASIC a stream of two or more characters in its place.

To accomplish this, it is necessary to install a filter between the keyboard and the BASIC interpreter. This would be a device whose action filters input data streams to produce output data.

We need a filter which translates some input characters to BASIC keywords, and leaves others alone. If the character we intercept from the keyboard is an uppercase letter, a number or a special symbol (@, <, +, etc.), our program should pass the character on to the caller unchanged.

However, if it is a lowercase letter (a-z), which is transmitted when the user hits the SHIFT key and a letter, the filter should

SHIFT for Keywords:

A PRINT@	N NEXT
B ELSE	O POKE
C CHR\$(	P PEEK(
D DATA	Q LEFT\$(
E RIGHT\$(	R RETURN
F FOR	S GOSUB
G GOTO	T TAB(
H RND(	U USING
I INPUT"	V STRING\$(
J READ	W MID\$(
K INKEY\$	X SET(
L LEN(	Y THEN
M ASC(	Z RESET(

CLEAR—START/END Definition
Down Arrow—User String

Table 3. Reference chart to tape on your monitor.

Input	ASCII Value	Output
Special characters	0-25	Same as input
SHIFT/Down Arrow	26	Substitute user-defined string (up to 64 chars)
Special characters	27-30	Same as input
SHIFT/CLEAR	31 & Shift*	None (Start/end user string definition)
Special characters and numbers	32-64	Same as input
Uppercase letters	65-90	Same as input
Special characters	91-96	Same as input
Lowercase letters	97-122	Substitute a BASIC keyword
Special characters	123-127	Same as input

*Since the keyboard driver returns 31 for both SHIFT/CLEAR and CLEAR, we must test for the Shift key separately.

Table 1. Function of keyboard filter routine.

Input	ASCII Value	Output
Special characters	0-25	Same as input
Shift-Down Arrow	26	Substitute user-defined string (up to 64 chars)
Special characters	27-30	Same as input
Shift-Clear	31 & Shift*	None (Start/end user string definition)
Special characters	32-64	Same as input

RAM Size	ORG of Program	Answer MEMORY SIZE?
16K	7E58H	32361
32K	BE58H	48745
48K	FE58H	65129

Table 2. Origin of program and MEMORY SIZE for different RAM sizes.

Program Listing

```

00010 ; ONESTR - ONE STROKE KEYWORD ENTRY PROGRAM. INTERCEPTS
00020 ; LOWER-CASE CHARACTERS AND REPLACES THEM WITH
00030 ; KEYWORD STRINGS. ALSO ALLOWS THE USER TO ASSIGN A
00040 ; STRING OF UP TO 64 BYTES TO 'SHIFT-DOWN ARROW'.
00050 ; DEFINITION OF THIS STRING IS INITIATED AND
00060 ; TERMINATED BY 'SHIFT-CLEAR'.
00070 ;
00080 ; REV 2.2 2/9/79
00090 ;
00100 ; BY ROWLAND ARCHER
00110 ; FLINT RIDGE 59
00120 ; HILLSBOROUGH, NC 27278
00130 ;
4016 00140 KEYDRV EQU 4016H ;ADDRESS IN KEYBOARD DCB
00150 ; OF DRIVER ROUTINE
3880 00160 SHIFT EQU 3880H ;(3880H) IS 1 IF 'SHIFT'
00170 ; KEY IS PRESSED
033A 00180 PUTC EQU 033AH ;PUT CHAR IN A ON SCREEN
00CD 00190 CALL EQU 0CDH ;'CALL' OPCODE VALUE
001F 00200 DEFKEY EQU 31 ;'SHIFT-CLEAR' KEY
001A 00210 UDSKEY EQU 26 ;'RETURN USER-DEF STRING'
00220 ; KEY = 'SHIFT-DOWN ARROW'
0040 00230 USTLEN EQU 64 ;USER-DEFINED STRING LENGTH
00240 ;
00250 ;THE FOLLOWING INITIALIZATION CODE IS PERFORMED ONLY
00260 ;WHEN THIS ROUTINE IS LOADED AND RUN THE FIRST TIME.
00270 ;
7E58 00280 ORG 07E58H ;ORG FOR 16K SYSTEM
7E58 2A1640 00290 INIT LD HL,(KEYDRV) ;GET ADDR OF KEYBRD DRIVER
7E5B 224E7F 00300 LD (KEYDR1),HL ; ROUTINE AND BUILD TWO
7E5E 22B07F 00310 LD (KEYDR2),HL ; CALL INSTRUCTIONS IN
00320 ; THIS CODE WITH IT
7E61 21477F 00330 LD HL,ONESTR ;NOW PUT THE ADDRESS OF THE
7E64 221640 00340 LD (KEYDRV),HL ; ENTRY PT TO THIS ROUTINE
00350 ; INTO THE KEYBOARD DCB
00360 ;*****
00370 ;YOU MUST CHOOSE ONLY ONE OF THE FOLLOWING TWO JUMP
00380 ;INSTRUCTIONS TO EXIT THIS INITIALIZATION CODE.
00390 ;IF YOU ARE GOING TO LOAD THIS PROGRAM FROM DISK WHILE
00400 ;IN DOS, USE
00410 ; JP 402DH ; TO RETURN TO DOS
00420 ;IF YOU ARE GOING TO LOAD FROM TAPE WHILE IN BASIC, USE
00430 ; JP 1A19H ; TO RETURN TO BASIC
00440 ;*****
00450 ;
00460 ; ABOVE CODE IS ONLY USED ONCE AND CAN BE OVERWRITTEN
00470 ; AFTER IT RUNS - SO 'MEMORY SIZE?' PROTECTIONS STARTS
00480 ; WITH THE FOLLOWING DATA STRUCTURES:
00490 ;
7E6A 52 00500 USTR DEFM 'RUN' ;USER STRING; INITIALLY
7E6D 0D 00510 DEFB 0DH ; 'RUN <ENTER>'
7E6E 00 00520 DEFB 0 ;END OF STRING
0005 00530 USED EQU $-USTR ;SIZE OF PREDEFINED STRING
003B 00540 REST DEFS USTLEN-USED ;ALLOCATE SPACE FOR REST
00550 ; OF USER-DEFINED STRING
7EAA 00 00560 DEFB 0 ;FORCE END OF STRING
7EAB 00 00570 OSFLAG DEFB 0 ;ONE-STROKE FLAG: = 1 WHILE
00580 ; WE ARE SUBSTITUTING FOR A
00590 ; LOWER-CASE CHARACTER
7EAC 0000 00600 OSPTR DEFW 0 ;ADDRESS OF CURRENT CHAR
00610 ; IN SUBSTITUTE STRING
00620 ;
00630 ;TABLE OF STRINGS TO SUBSTITUTE FOR LOWER-CASE CHARS.
00640 ;STRINGS ARE TERMINATED BY NULL (0) BYTES. STRING
00650 ;LABELLED 'LA' IS SUBSTITUTED FOR 'SHIFT-A', 'LB'
00660 ;FOR 'SHIFT-B', ETC. EXCEPT FOR 'LA', LABELS
00670 ;ARE NOT REQUIRED, AND ARE ONLY INCLUDED FOR EASE IN
00680 ;DETERMINING THE STRING TO BE SUBSTITUTED FOR EACH LETTER.
00690 ;
7EAE 50 00700 LA DEFM 'PRINT@'
7EB4 00 00710 DEFB 0 ;ZERO BYTE END OF STRING
7EB5 45 00720 LB DEFM 'ELSE'
7EB9 00 00730 DEFB 0
7EBA 43 00740 LC DEFM 'CHR$(
7EBF 00 00750 DEFB 0
7EC0 44 00760 LD DEFM 'DATA'
7EC4 00 00770 DEFB 0
7EC5 52 00780 LE DEFM 'RIGHT$(
7ECC 00 00790 DEFB 0
7ECD 46 00800 LF DEFM 'FOR'
7ED0 00 00810 DEFB 0
7ED1 47 00820 LG DEFM 'GOTO'
7ED5 00 00830 DEFB 0
7ED6 52 00840 LH DEFM 'RND('
7EDA 00 00850 DEFB 0
7EDB 49 00860 LI DEFM 'INPUT'
7EE1 00 00870 DEFB 0
7EE2 52 00880 LJ DEFM 'READ'
7EE6 00 00890 DEFB 0

```

Program continues

replace that letter in the input stream with a BASIC keyword.

To do this, when a lowercase letter is read from the keyboard set a substitution flag in the routine, indicating that keyword substitution has begun. Use the ASCII value of the letter as an index to a table of BASIC keywords. Pass BASIC the first letter of the indexed keyword instead of the lowercase letter read from the keyboard.

When BASIC calls for input from the keyboard again, the routine will note that the substitution flag is set and will send back the next character of the keyword, without bothering to look at the keyboard to see if any keys are pressed. This continues until the entire keyword is sent. Then the flag is reset to normal operation until the next lowercase letter code is received. All this happens so quickly that the keyword seems to appear on the screen the instant the key is pressed.

Note that only 26 keywords can be handled with this method. However, it is possible to select a group of keywords which are either frequently used, difficult to type or both. You can experiment by including different keywords until you find the best subset for your needs. I have found the set of 26 chosen here to be very useful.

Intercepting Input

Since the routine will be used while editing BASIC programs, the easiest approach is to write an assembly language routine to look at characters before the BASIC editor scans them.

Take a look at the memory map in the back of your Level II BASIC manual. At location 4015H (hexadecimal) in the BASIC Reserved RAM area, there is a device control block for the keyboard.

Location 4016H is initialized by BASIC with the address of the keyboard driver routine. A call to this routine returns with 0 in the A register if no key is pressed, or the ASCII value of the key if one is pressed (like an assembly language INKEY\$ routine).

Load the routine into high


```

7EE7 49      00900 LK      DEFM  'INKEY$'
7EED 00      00910      DEFB  0
7EEE 4C      00920 LL      DEFM  'LEN('
7EF2 00      00930      DEFB  0
7EF3 41      00940 LM      DEFM  'ASC('
7EF7 00      00950      DEFB  0
7EF8 4E      00960 LN      DEFM  'NEXT'
7EFC 00      00970      DEFB  0
7EFD 50      00980 LO      DEFM  'POKE'
7F01 00      00990      DEFB  0
7F02 50      01000 LP      DEFM  'PEEK('
7F07 00      01010      DEFB  0
7F08 4C      01020 LQ      DEFM  'LEFT$('
7F0E 00      01030      DEFB  0
7F0F 52      01040 LR      DEFM  'RETURN'
7F15 00      01050      DEFB  0
7F16 47      01060 LS      DEFM  'GOSUB'
7F1B 00      01070      DEFB  0
7F1C 54      01080 LT      DEFM  'TAB('
7F20 00      01090      DEFB  0
7F21 55      01100 LU      DEFM  'USING'
7F26 00      01110      DEFB  0
7F27 53      01120 LV      DEFM  'STRING$('
7F2F 00      01130      DEFB  0
7F30 4D      01140 LW      DEFM  'MID$('
7F35 00      01150      DEFB  0
7F36 53      01160 LX      DEFM  'SET('
7F3A 00      01170      DEFB  0
7F3B 54      01180 LY      DEFM  'THEN'
7F3F 00      01190      DEFB  0
7F40 52      01200 LZ      DEFM  'RESET('
7F46 00      01210      DEFB  0
              01220 ;
              01230 ;MAIN ROUTINE ENTRY POINT:
              01240 ;
7F47 3AAB7E  01250 ONESTR LD    A,(OSFLAG) ;IF FLAG<>0 WE ARE IN THE
7F4A B7      01260      OR    A          ;MIDDLE OF A SUBSTITUTION
7F4B 2038    01270      JR    NZ,SUBST  ;CONTINUE SUBSTITUTION
              01280 ;
              01290 ;CALL NORMAL ROUTINE TO GET CHARACTER FROM KEYBOARD
              01300 ;
7F4D CD      01310      DEFB  CALL      ;BECOMES 'CALL GET-CHAR'
7F4E 0000    01320 KEYDR1 DEFW  0        ; WHEN INITIALIZATION CODE
              01330 ; PUTS ADDRESS OF KEYBOARD
              01340 ; DRIVER ROUTINE HERE
              01350      OR    A          ;CHARACTER RETURNED IN A
7F50 B7      01360      RET    Z        ;0 MEANS NO KEY PRESSED,
7F51 C8      01370 ;SO JUST RETURN TO CALLER
              01380 ;
              01390 ;A KEY HAS BEEN PRESSED, HANDLE IT IF IT IS 'DEFKEY',
              01400 ;'UDSKEY' OR LOWER-CASE LETTER; ELSE JUST RETURN IT.
              01410 ;
7F52 FEF1    01420      CP    DEFKEY    ;DEFINE USER STRING?
7F54 2840    01430      JR    Z,DEFINE ;YES, GO DO IT
7F56 FEF1    01440      CP    UDSKEY    ;REQUESTING USER STRING?
7F58 2808    01450      JR    Z,SUBMOD  ;YES, START SUBSTITUTION
7F5A FE61    01460      CP    97        ;KEY < LOWER-CASE A?
7F5C D8      01470      RET    C        ;YES, RETURN UNCHANGED
7F5D FE7B    01480      CP    123      ;KEY < LOWER-CASE Z + 1?
7F5F 3801    01490      JR    C,SUBMOD  ;YES, SUBSTITUTE
7F61 C9      01500      RET            ;NO, RETURN UNCHANGED
              01510 ;
              01520 ;START NEW SUBSTITUTION - SET OSFLAG = 1,
              01530 ;SET POINTER TO STRING TO SUBSTITUTE
              01540 ;
7F62 E5      01550 SUBMOD  PUSH    HL      ;USER-DEFINED STRING?
7F63 FEF1    01560      CP    UDSKEY    ;YES, GO DO IT
7F65 2005    01570      JR    NZ,KEYWRD ;NO, IT'S KEYWORD
7F67 216A7E  01580      LD    HL,USTR   ;YES, GO SAVE POINTER TO
7F6A 1810    01590      JR    SRCHDN   ; STRING AND SET MODE FLAG
              01600 ;
              01610 ;KEY PRESSED WAS A LOWER-CASE LETTER. SET POINTER TO FIRST
              01620 ;CHARACTER OF KEYWORD TO SUBSTITUTE FOR IT.
              01630 ;
7F6C 21AE7E  01640 KEYWRD LD    HL,LA      ;BASE OF SUBST-STRING TABLE
7F6F D661    01650      SUB    97        ;SUBTRACT ASCII(LOWER-CASE
              01660 ; A) FROM KEY PRESSED
              01670      OR    A          ;ZERO => LOWER-CASE A
7F71 B7      01680      JR    Z,SRCHDN  ; PRESSED, END SEARCH
7F72 2808    01690      LD    B,A        ;ELSE A HOLDS NUMBER OF
7F74 47      01700      LD    A,(HL)    ; KEYWORDS TO SKIP OVER TO
7F75 7E      01710      INC    HL        ; FIND STRING TO SUBSTITUTE
7F76 23      01720      OR    A          ;
7F77 B7      01730      JR    NZ,NXTC   ; INNER LOOP FINDS NULL
7F78 20FB    01740      DJNZ    NXTC    ; END-OF-STRING BYTES
              01750 ; OUTER LOOP COUNTS KEYWORDS
7F7A 10F9    01760 ;
              01770 ;END SEARCH - HL HAS POINTER TO DESIRED STRING
              01780 ;
7F7C 22AC7E  01790 SRCHDN LD    (OSPTR),HL ;SAVE POINTER TO STRING
7F7F 3E01    01800 SETMD  LD    A,1      ;SUBSTITUTION MODE STARTS

```

memory, where it can be protected from BASIC by answering the MEMORY SIZE? prompt appropriately on startup. When it is first run, it will grab the address of the keyboard driver routine from location 4016H and save it for later use. It then stores the address of its own entry point at 4016H, so that every routine (in ROM or elsewhere) which used to call the keyboard driver directly will now call this routine instead.

The normal keyboard driver is called as a subroutine to read from the keyboard. If no key is pressed, the subroutine will return a zero to the accumulator (register A); in this case we return to the caller without changing a thing.

If a key has been pressed, it is examined as discussed above, and if it is a lowercase alphabetic code, the keyword substitution routine begins.

A User Defined Key

The above technique allows entry of 26 BASIC keywords with a single keystroke, and by itself will save a lot of typing. But many BASIC programs use the same expression over and over again; it would be convenient to enter a phrase once and then recall it with a single keystroke.

To do this, a key must be defined whose substitution value can be changed dynamically, without having to reassemble and reload the assembly language routine. This feature is easily added by declaring one key as the "define user string" key. This routine uses SHIFT/CLEAR. The "substitute user defined string" key is the shifted down arrow.

These keys can be located in the input stream in the same way shifted alphabetic characters are intercepted. When SHIFT/CLEAR is pressed, a START DEFINITION prompt is printed on the screen. Each character typed, up to 64 characters, is saved in memory until SHIFT/CLEAR is hit again. This terminates the definition of the string. END DEFINITION is written on the screen.

Now when SHIFT plus the down arrow are pressed, the defined string is returned. Table 1 gives a summary of the actions the filter routines will perform for the range of possible keyboard inputs.

The origin shown in the Program Listing of ONESTR is for a 16K machine. Table 2 gives the ORG value to substitute, as well as the appropriate answers to the MEMORY SIZE? prompt, for 32K and 48K machines.

At label INIT you will find the initialization code, which must be executed once when ONESTR is loaded. This code retrieves the address of the current keyboard driver routine from the keyboard device control block and stores it after the CALL opcodes at labels KEYDR1 and KEYDR2.

Program continues

```

7F81 32AB7E 01810 LD (OSFLAG),A
7F84 E1 01820 POP HL ;RESTORE HL
01830 ;
01840 ;BRANCH HERE WHEN WE ARE DOING A SUBSTITUTION
01850 ;
7F85 E5 01860 SUBST PUSH HL ;SAVE HL
7F86 2AAC7E 01870 LD HL, (OSPTR) ;GET CURRENT CHARACTER
7F89 7E 01880 LD A, (HL) ;OF SUBSTITUTION STRING
7F8A B7 01890 OR A ;NULL END-OF-STRING?
7F8B 2003 01900 JR NZ,NOTEND ;NO, MORE TO GO
7F8D 32AB7E 01910 LD (OSFLAG),A ;YES, END SUBSTITUTION
7F90 23 01920 NOTEND INC HL ;BUMP POINTER TO NEXT
7F91 22AC7E 01930 LD (OSPTR),HL ; CHARACTER AND SAVE IT
7F94 E1 01940 POP HL ;RESTORE HL
7F95 C9 01950 RET ;RETURN CHARACTER IN A
01960 ;
01970 ;DEFINITION OF USER STRING
01980 ;
7F96 3A8038 01990 DEFINE LD A, (SHIFT) ;SHIFT DEPRESSED?
7F99 B7 02000 OR A ; (DEFINE ON 'SHIFT-CLEAR')
7F9A 2004 02010 JR NZ,DEF ;YES, DEFINE IT
7F9C 3E1F 02020 LD A,DEFKEY ;NO, RETURN 'CLEAR'
7F9E B7 02030 OR A ;SET FLAGS FOR CALLER
7F9F C9 02040 RET ;RETURN CHAR IN A
02050 ;
7FA0 C5 02060 DEF PUSH BC ;SAVE CALLER'S BC
7FA1 E5 02070 PUSH HL ;SAVE CALLER'S HL
7FA2 21DE7F 02080 LD HL,STRTDF ;PUT PROMPT FOR START OF
7FA5 CDD57F 02090 CALL PUTSTR ; USER STRING DEFINITION
7FA8 216A7E 02100 LD HL,USTR ;POINTER TO USER STRING AREA
7FAB 0640 02110 LD B,USTLEN ;MAX SIZE OF USER STRING
7FAD E5 02120 GETC PUSH HL ;SAVE OUR HL
7FAE C5 02130 PUSH BC ;SAVE OUR BC
7FAF CD 02140 DEFB CALL ;BECOMES 'CALL GET-CHAR'
7FB0 0000 02150 KEYDR2 DEFW 0 ;ADDR OF KEY DRIVER HERE
7FB2 C1 02160 POP BC ;RESTORE OUR BC
7FB3 E1 02170 POP HL ;RESTORE OUR HL
7FB4 B7 02180 OR A ;IS A NON-ZERO?
7FB5 28F6 02190 JR Z,GETC ;LOOP UNTIL KEY PRESSED
7FB7 FE1F 02200 CP DEFKEY ;END DEFINITION?
7FB9 2008 02210 JR NZ,NTENDF ;NOT END DEFINITION CHAR
7FBB 3A8038 02220 LD A, (SHIFT) ;SHIFT KEY PRESSED?
7FBE B7 02230 OR A ;NOT ZERO IF IT IS
7FBF 2009 02240 JR NZ,ENDDEF ;YES, END DEFINITION
7FC1 3E1F 02250 LD A,DEFKEY ;RESTORE A
7FC3 77 02260 NTENDF LD (HL),A ;ADD CHAR TO USER STRING
7FC4 23 02270 INC HL ;BUMP POINTER TO USER STRING
7FC5 CD3A03 02280 CALL PUTC ;ECHO KEY PRESSED
7FC8 10E3 02290 DJNZ GETC ;REPEAT IF MAX STRING
02300 ; LENGTH NOT YET EXCEEDED
7FCA AF 02310 ENDEF XOR A ;PUT NULL END-OF-STRING
7FCB 77 02320 LD (HL),A ; MARKER AFTER USER STRING
7FCC 21EF7F 02330 LD HL,ENDMSG ;PUT OUT 'END OF DEF' MSG
7FCE CDD57F 02340 CALL PUTSTR ;ALSO LEAVES 0 IN A
7FD2 E1 02350 POP HL ;RESTORE CALLER'S HL
7FD3 C1 02360 POP BC ;RESTORE CALLER'S BC
7FD4 C9 02370 RET ;AND RETURN TO CALLER
02380 ;
02390 ;PUTSTR: PUT STRING AT (HL) ON SCREEN. STRING IS
02400 ; TERMINATED BY A 0 BYTE.
02410 ;
7FD5 7E 02420 PUTSTR LD A, (HL) ;GET CHARACTER FROM STRING
7FD6 B7 02430 OR A ;IF CHARACTER IS NULL (0)
7FD7 C8 02440 RET Z ;THEN FINISHED
7FD8 CD3A03 02450 CALL PUTC ;ELSE PUT CHAR ON SCREEN
7FDB 23 02460 INC HL ;POINT AT NEXT CHARACTER
7FDC 18F7 02470 JR PUTSTR ;AND GO GET IT
02480 ;
02490 ;PROMPT MESSAGES:
7FDE 0D 02500 STRTDF DEFB 0DH ;CARRIAGE RETURN
7FDF 44 02510 DEFB 'DEFINE STRING:'
7FE0 0D 02520 DEFB 0DH
7FEE 00 02530 DEFB 0 ;END OF STRTDF
7FEF 0D 02540 ENDEF DEFB 0DH ;CARRIAGE RETURN
7FF0 45 02550 DEFB 'END DEFINITION'
7FFE 0D 02560 DEFB 0DH
7FFF 00 02570 DEFB 0 ;END OF ENDEF
7E58 02580 END INIT
00000 TOTAL ERRORS

```

```

CALL 00CD 00190 01310 02140
DEF 7FA0 02060 02010
DEFINE 7F96 01990 01430
DEFKEY 001F 00200 01420 02020 02200 02250
ENDEF 7FCA 02310 02240
ENDMSG 7FEF 02540 02330
GETC 7FAD 02120 02190 02290
INIT 7E58 00290 02580
KEYDR1 7F4E 01320 00300
KEYDR2 7FB0 02150 00310

```

Program continues

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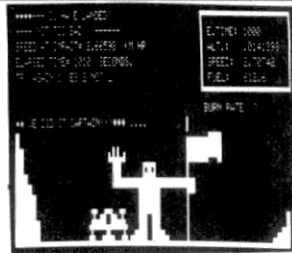
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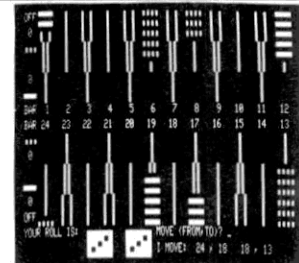
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LC	7EBA	00740		
LD	7EC0	00760		
LE	7EC5	00780		
LF	7ECD	00800		
LG	7ED1	00820		
LH	7ED6	00840		
LI	7EDB	00860		
LJ	7EE2	00880		
LK	7EE7	00900		
LL	7EEE	00920		
LM	7EF3	00940		
LN	7EF8	00960		
LO	7EFD	00980		
LP	7F02	01000		
LQ	7F08	01020		
LR	7F0F	01040		
LS	7F16	01060		
LT	7F1C	01080		
LU	7F21	01100		
LV	7F27	01120		
LW	7F30	01140		
LX	7F36	01160		
LY	7F3B	01180		
LZ	7F40	01200		
NOTEND	7F90	01920	01900	
NTENDF	7FC3	02260	02210	
NXTC	7F75	01700	01730	01750
ONESTR	7F47	01250	00330	
OSFLAG	7EAB	00570	01250	01810 01910
OSPTR	7EAC	00600	01790	01870 01930
PUTC	033A	00180	02280	02450
PUTSTR	7FD5	02420	02090	02340 02470
REST	7E6F	00540		
SETMD	7F7F	01800		
SHIFT	3880	00160	01990	02220
SRCHDN	7F7C	01790	01590	01680
STRTDF	7FDE	02500	02080	
SUBMOD	7F62	01550	01450	01490
SUBST	7F85	01860	01270	
UDSKEY	001A	00210	01440	01560
USED	0005	00530	00540	
USTLEN	0040	00230	00540	02110
USTR	7E6A	00500	00530	01580 02100

Level II BASIC, TRSDOS 2.1, 2.2 and NEWDOS all use different keyboard drivers. By picking up the address they have already put in the device control block, it is possible to reap the benefits (debounce, etc.) of these drivers and the benefits of ONESTR at the same time. The address of label ONESTR is installed in the device control block so that it is called in the future for keyboard input.

Choose an Instruction

Choose one of two instructions, depending on whether you will be loading ONESTR from tape or disk. If you will load ONESTR from disk, you must use JP 402DH to return to TRSDOS or NEWDOS. If you will be loading from tape with the SYSTEM command in BASIC, use a JP 1A19H to return to BASIC.

Note that the space taken up by this initialization code can be reused after it is run, since the

code is no longer needed. The answers to the MEMORY SIZE? prompt are given in Table 2 and reflect this reuse of space.

At label USTR allocate 64 bytes for the user-defined string and give it an initial value of RUN. Until redefined, this will run a BASIC program by typing SHIFT/down arrow. This may be changed to any other initial value you like, and the code at label REST will allocate the remainder of the 64-byte buffer. A zero byte after the string serves as the string terminator.

Beginning at label LA the table of strings to be substituted for the lowercase letters are listed. Except for LA, the labels are included strictly for convenience in determining which keyword gets substituted for which letter; they are not needed by the code.

This is where you would substitute assembly language mnemonics, Pascal keywords or

anything else you would like to type with one key stroke. If you do make substitutions which cause the length of the program to change, be sure to change the program origin so it will fit in your machine! Adjust your answer to the MEMORY SIZE? prompt in this case to protect the new size of the program. Again, a zero byte at the end of each string in the table serves as a terminator.

Selecting Keywords

I chose not to include an entry for PRINT, which is certainly a commonly used BASIC keyword. The Level II BASIC handbook explains that a question mark is a built-in abbreviation for PRINT.

I did choose to include PRINT@ as a keyword, even though typing ?@ works as well and is almost as easy. The reasoning behind this is that @ and SHIFT @ appear the same on the screen, but SHIFT @ doesn't work as a PRINT qualifier. It's a nasty bug to catch

since a listing appears normal. Including PRINT@ as a one-stroke entry avoids the problem.

ONESTR is the main entry point to the program, and this is where control is transferred whenever keyboard entry is requested. The OS FLAG is tested to see if the routine is in the middle of a keyword substitution. If so, it branches to SUBST and continues with the substitution. Otherwise, the routine whose address was in the keyboard device control block before ONESTR was loaded is called for keyboard input. If no key has been pressed, it returns to the caller. If a key has been pressed, a decision is made about the next action to take, based on the key's ASCII value (as shown in Table 1).

If the keyboard input is a lowercase letter, the OS flag is set on. Search the keyword table sequentially to find the start of the keyword to substitute.

The number of keywords to skip is calculated from the ASCII value of the lowercase let-



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ter read from the keyboard, minus the ASCII value of lowercase a. Since each keyword is terminated by a zero byte, start at the head of the table and check each character. Continue until you pass as many zero bytes as the number of keywords you are supposed to skip.

Don't moan and groan about the inefficiency of a sequential search—it's easy to build an index for the address table and to put it into the routine so that the appropriate address may be computed.

To do this, use a DEFW pseudo-op instruction for each label whose address is included in the following table:

```
ADTABL  DEFW  LA
        DEFW  LB
        ...
        DEFW  LZ
```

The offset into the table for a lowercase letter, say b, is 2 * (ASCII(b)-ASCII(a)). The factor of 2 is used because of the two

bytes each entry takes. Load the HL register pair with the contents of this location and you've got the address of the first letter of the keyword.

Why not use this technique, then, instead of the sequential search? Because the address table takes up space. And although it does give faster results, the difference isn't noticeable at the keyboard.

Test the Shift Key

The code at the label DEFINE is executed when the CLEAR key is pressed. Since the keyboard driver routine returns the same value whether CLEAR is pressed alone or shifted, a test must be done to verify that the SHIFT key is indicated. Location 3880H contains a 1 if SHIFT is pressed, and a 0 otherwise. Checking 3880H determines whether to start user string definition, which is triggered by SHIFT/CLEAR.

Assuming SHIFT/CLEAR was pressed, the program types

DEFINE STRING: on the screen and waits for input. Each key pressed is tested to see if it is SHIFT/CLEAR, which ends the definition. If not, it is added to the user string buffer at USTR.

If 64 characters are typed without a SHIFT/CLEAR, then definition mode is automatically terminated. User string definition ends by returning a zero to the caller, indicating that no key was pressed. Thus the entire process is invisible to the calls. This process can be used with any program (BASIC, etc.) requesting keyboard input.

Note that most of the Level II BASIC string input editing is not implemented. The back arrow will delete a character, but SHIFT plus the back arrow will not delete the whole line.

Another design trade-off is reflected here. The ROM routines for string input editing could have been used, but they terminate input when BREAK or ENTER are pressed. The approach taken allows entire commands to be typed with one key-

stroke, including ENTER at the end of the command.

Running ONESTR

If you are loading from disk, run ONESTR from the DOS READY prompt. You can test it at this point by typing shifted letters; keywords should appear.

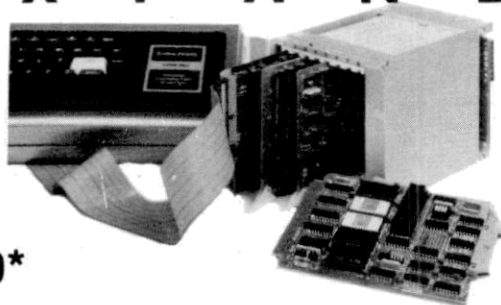
With either disk or tape, bring BASIC up, answering MEMORY SIZE? as shown in Table 2. Disk users should be in business at this point.

Tape users should enter the SYSTEM command, and load the object tape. Once loaded, run the program by hitting ENTER.

Table 3 is a handy listing of the keys to press for each keyword. Cut it out and tape it to your monitor for quick reference while you are getting used to the system.

Now it's time to find those back issues of *80 Microcomputing* and start enjoying all the programs that you were too lazy to type. ■

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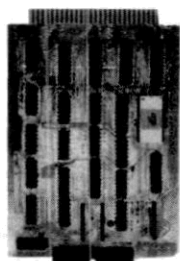
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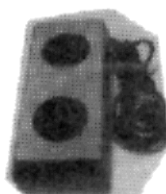
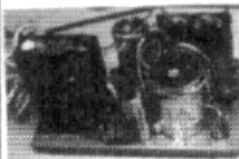
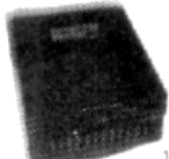
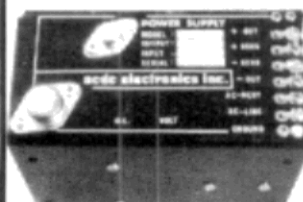
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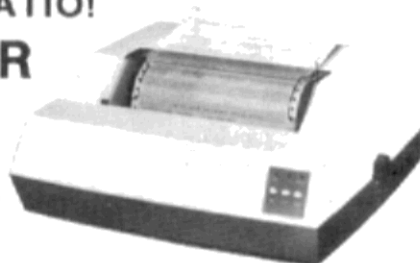
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Teletype Interface

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This article describes how to build and use a simple teletype (TTY) interface to work with a TRS-80 (Level II and up). By interrupting the normal TRS-80 input/output driver software, we can: output line print commands (including LISTS) to the TTY, have a keyed option to direct screen print commands simultaneously to the video and TTY, input characters to the computer from the TTY.

The following is a 110 baud version, but a few simple adjustments will allow I/O at other speeds.

Cheap Hard Copy

This design provides cheap, high quality hard copy.

In this interface, hardware and software work in conjunction; however, the bulk of the work rests with the software, allowing a greater degree of flexibility.

The hardware consists of a 556 dual timer I.C. and one medium gain NPN transistor, which draw their minimal power from the TRS-80 video socket, pin 1. The circuit is shown in Fig. 1, and a suitable layout on

0.1-inch matrix board in Fig. 2.

To avoid opening up the TRS-80, all signals are carried to the unit via DIN plugs from the video and cassette sockets. These signals are tapped off in the interface and made available again through DIN sockets at the rear. Fig. 3 shows this arrangement.

The only difficulty is that the TRS-80 cassette DIN plug is a non-standard plastic type and will not mate with the standard DIN socket in the interface. The simplest expedient is to remove this plug and replace it with a normal DIN type. The I/O to the TTY is via only three contacts of a 25-way socket. This provides a tidy, compact unit which may be

left hooked-up to the computer, even when the TTY is not in use.

Input to the TTY driver section comes from the cassette output port. This part of the circuit receives pulses determined by the software, then stretches them to the required pulse width, which in a 110 baud system is 9.09 ms.

A description of an ASCII character output shows how things happen. Suppose we wish to output to the TTY the letter J, which is 0100 1010 in binary. This is odd parity, so to make it even, the software adds a bit, and it now appears as 1100 1010. Before this is output, we need a zero start bit which indicates to the TTY that a byte follows. Now bits 0-7 of the byte are output, followed by two stop bits. The final output is a string of bits as follows:

```

0      01010011      11
start bit      J      stop bits
  
```

All the timing, data bits and start/stop bits are manipulated by the software (Program Listing), which receives characters by interrupting the normal flow of I/O. This I/O in the TRS-80 is handled by ROM driver routines which are pointed to by vectors in RAM. By placing our own routine addresses in these vectors we can handle I/O as we like. The vectors are at these locations:

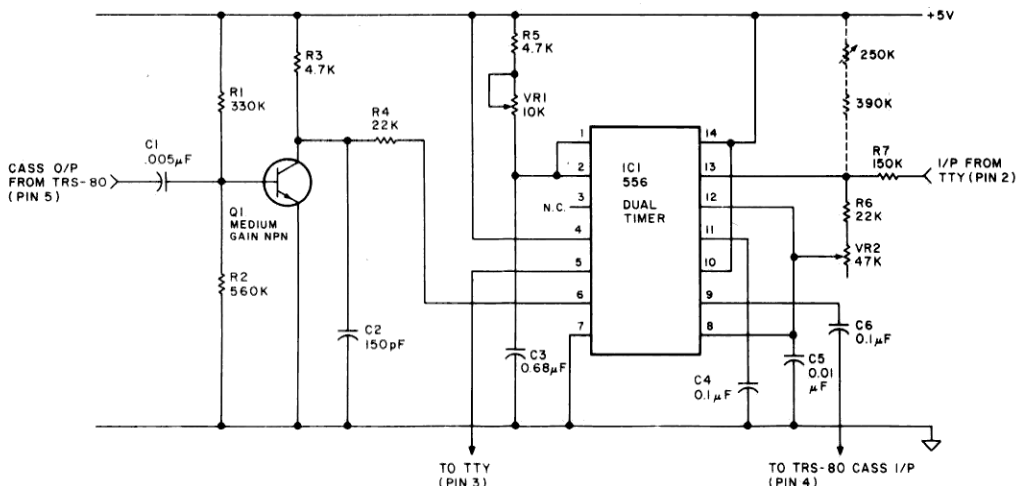


Fig. 1.

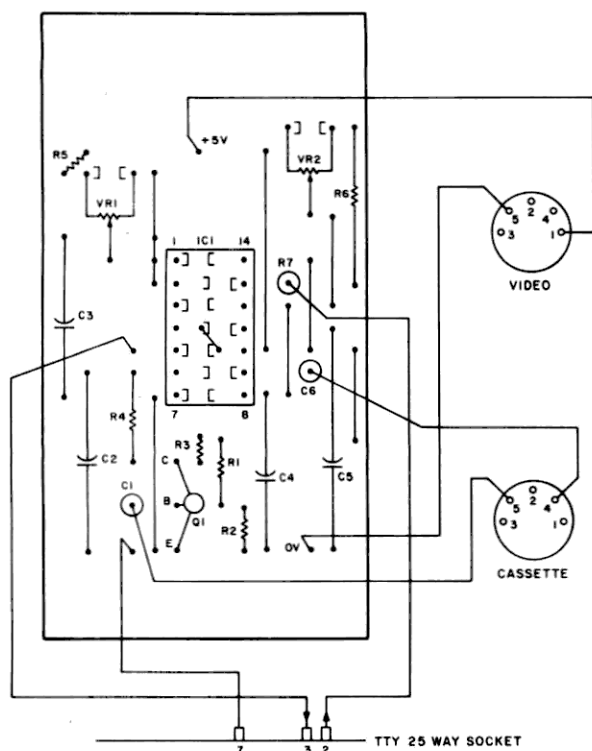


Fig. 2.

16406 + 7 — keyboard driver
16414 + 5 — video driver
16422 + 3 — line print driver

The heart of the TTY output software is the routine called OUT, which is called every time a zero bit is to be output. This issues a positive-going pulse of about 0.1 ms. to transistor Q1, inverting the pulse to trigger the pulse-stretcher half of the 556.

This, in turn, switches high for

9.09 ms. (determined by time-constant $R5/VR1/C3$) satisfying the requirement of the TTY. To output a one, the routine is merely ignored for 9.09 ms., as the 556 reverts from a zero after its time-constant has expired. The rest of the routine shifts the character and tests each bit to see if a zero or one is required.

Adjusting VR1

When the software is loaded

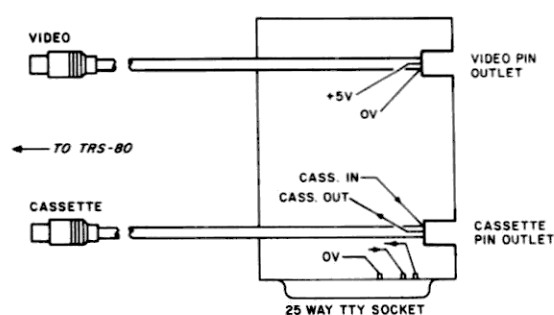


Fig. 3.

and the TTY hooked up, the simplest way to adjust preset VR1 is to line print an unbroken string of U*. These two characters have bit patterns of 01010101 and 10101010, which are ideal for testing.

VR1 should then be adjusted for a mid position that prints the string with no errors. To increase the baud rate to 300, the time constants at NBIT and WT are altered to 218 and 652, respectively. VR1 is then adjusted as above to give a 3.33 ms. pulse. Other baud rates can be accommodated in the same way.

To perform LPRINTS and LISTS, the line print vector at 16422 is replaced with the address of the TTY driver routine described above. To get the option of screen print to TTY, the vector at 16414 is then pointed at the routine SPRINT. This routine always prints on the screen first, and, before outputting to

the TTY, checks to see if the character is either an up arrow or a shift @. If it is a shift @, the routine disables itself from any further screen-to-TTY output; if it is an up arrow, the output is enabled. Keying or printing these characters allows this option to be switched on or off.

The keyboard input from the TTY is handled by the other half of the 556, which triggers an unstable pulse. When the TTY outputs zero bits, the 556 chops the voltage into pulses that can be detected when input through the cassette port.

If the voltage wasn't chopped, then there would be no way of knowing whether consecutive bits were zeros or ones. The cas-

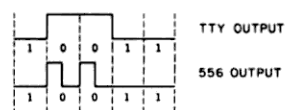


Fig. 4.

Program Listing.

```
00050 ORG 7E00H
00060 SETU LD HL,SPRINT
00070 LD (16414),HL;SCRN PRNT DR ADDR
00080 LD HL,LPRINT
00090 LD (16422),HL;LINE PRNT DR ADDR
00100 LD HL,START
00110 LD (16406),HL;KBD DR ADDR
00120 JP 6CCH ;TO TRSDOS DO A 'RET'
00130
00140 SPRINT CALL 1112 ;PRINT ON SCREEN
00150 PUSH AF
00160 CALL CHKIT ;CHECK TTY PRNT
00170 POP AF
00180 RET
00190 ***ENTERS WITH CHAR. IN C***
00200 CHKIT LD A,C
00210 LD HL,LP
00220 CP 96 ;SHIFT @ - DISABLE
00230 JR NZ,CHK27
00240 LD (HL),201 ;RET
00250 CP 91 ;UP-ARROW - ENABLE
00260 JR NZ,LP
00270 LD (HL),183 ;OR A
00280 LP RET ;INITIALLY DISENGAGED
00290 LD HL,CHAR
00300 CP (HL)
00310 LD (HL),0 ;TURN OFF TTY FLAG
```

```
00320 RET Z ;DON'T PRNT IF TTY CHR
00330 CP 14
00340 JR C,LPRINT ;C/R L/F ETC
00350 CP 16
00360 RET C ;CSRSR ON/OFF
00370 CP 28
00380 JR C,LPRINT ;CSRSR MOVES
00390 CP 32
00400 JR C,CRLF ;SCREEN CNTROLS
00410 LPRINT LD A,C ;LINE PRINT ENTRY
00420 CP 10
00430 JR C,NOLF
00440 CP 14
00450 JR C,CRLF
00460 NOLF LD A,C
00470 AND 0C0H ;TAB?
00480 CP 0C0H
00490 LD A,C
00500 JR NZ,TBC ;NO
00510 PUSH BC
00520 LD A,3FH ;MASK
00530 AND C ;= # TAB SPACES
00540 LD B,A
00550 LD C,20H
00560 TAB CALL LPRINT
00570 DJNZ TAB
00580 POP BC
```

Program continues

All programs for TRS-80
16k, Level II computer.

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by John Laurence, Rick Sothen and Walter Gavenda from Acorn
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```

00590 RET
00600 TBC CALL PRNT
00610 LD A,0 ;WILL BE CHR CNT
00620 CRCNT EQU $-1
00630 DEC A
00640 LD (CRCNT),A
00650 RET NZ
00660 CRLF LD A,13 ;C/R
00670 CALL PRNT
00680 LD HL,5000 ;TIME FOR
00690 CALL WAIT ;CARRIAGE RETURN
00700 LD A,10 ;LINE FEED
00710 CALL PRNT
00720 LLEN LD A,64 ;CHRS PER LINE
00730 LD (CRCNT),A
00740 RET
00750 PRNT DI
00760 OR A ;CHK PARITY
00770 JP PE,P1 ;NO PRY BIT NEEDED
00780 OR 128 ;IF ODD PARITY
00790 P1 LD D,A
00800 CALL OUT ;0 START BIT
00810 LD E,8
00820 NBIT LD HL,625 ;110 BAUD DLY
00830 CALL WAIT
00840 LD A,D
00850 AND 1 ;0 BIT TO BE O/P?
00860 JR NZ,SHIFT;IF NOT
00870 CALL OUT ;O/P 0 BIT
00880 SHIFT SRL D
00890 DEC E
00900 JR NZ,NBIT
00910 EI
00920 WT LD HL,2300 ;TIME FOR STOP BITS
00930 WAIT DEC HL
00940 LD A,L ;* DELAY
00950 OR H ;* LOOP
00960 JR NZ,WAIT ;*
00970 RET
00980 OUT LD A,1
00990 OUT (255),A ;PULSE LOW
01000 LD A,14 ;PULSE
01010 PLSE DEC A ;WIDTH
01020 JR NZ,PLSE ;DELAY
01030 LD A,2
01040 OUT (255),A ;PULSE HIGH
01050 RET
01060
01070 START DI
01080 IN A,(255)
01090 AND 80H ;TEST, AND..
01100 JR NZ,GBIT ;GOT A START BIT
01110 EI
01120 JP 995 ;TRY TRS-80 KBD
01130 GBIT LD B,8
01140 NXBIT CALL INBT ;GET I/P BIT
01150 LD HL,CHAR ;ADDR OF CHR
01160 SRL (HL) ;SHFT RDY FOR
01170 OR (HL) ;NEXT BIT
01180 LD (HL),A ;RE-STORE
01190 DJNZ NXBIT ;IF MORE BITS
01200 PUSH AF
01210 CALL INBT ;1ST STOP BIT
01220 CALL INBT ;2ND STOP BIT
01230 EI
01240 JR NZ,STOP ;MUST BE NZ
01250 POP AF ;ASSUME BREAK
01260 LD A,1 ;LIKE ROM
01270 PUSH AF
01280 JR LF
01290 STOP POP AF
01300 INC A ;TEST CHR
01310 JR Z,START ;IGNORE IF DEL
01320 DEC A ;TEST CHR
01330 JR Z,START ;IGNORE IF NUL
01340 AND 7FH ;CHOP PARITY BIT
01350 LD (CHAR),A ;STORE WITH NO PARITY
01360 PUSH AF
01370 CP 13 ;C/R?
01380 JR NZ,FINI
01390 LF CALL CRLF
01400 FINI POP AF
01410 RET
01420 INBT LD HL,15AH ;WAIT FOR RESET
01430 LD WAIT
01440 (255),A ;RESET LATCH
01450 LD HL,12DH ;WAIT FOR I/P
01460 CALL WAIT
01470 IN A,(255) ;GET LATCH STATE
01480 CPL ;GET RIGHT WAY RND
01490 AND 80H ;ELIM OTHER BITS
01500 POP HL
01510 RET
01520
01530 CHAR DEFB 0 ;TTY CHR STORE
01540 END SETU

```

sette input latch is only set when a pulse is input to it. If a steady voltage caused by a sequence of zeros or ones is input, then it just remains in its last latched state. Fig. 4 shows how this is overcome.

Fig. 4 shows that the cassette input latch will be set/reset during a zero and reset during a one. This is detected by the software and merged into a byte.

If the software does not detect a start byte during its scan, then the TRS-80 keyboard is strobed, allowing either keyboard to be used. The timing of this part of the circuit (VR2) must be set up with care. If the frequency from the 556 is too high, an extra transition is possible, which gives a false zero; if it is too low, then the software is likely to detect a pulse hanging over from the previous one.

Break Detection

A simple break detection may be employed by connecting a 390K resistor in series with a

250K preset between the positive rail and the junction of R6 and R7. This causes the 556 to free-run if the TTY is disconnected, and the frequency can be set to represent a train of zeros, which can then be detected by software.

One useful bonus from using cassette pulses to drive the TTY is an off-line print facility. By recording the driver pulses on cassette and replaying them through the record jack, a print-out can be stored on cassette and output from cassette player to TTY as often as required without re-running the original program.

This gives you a unit which is even more versatile than a normal printer and can be used with or without an expansion interface. ■

Parts List

C1 .005 μ F	R1 330K
C2 150 pF	R2 560K
C3 .68 μ F	R3, R5 4K7
C4, C6 .1 μ F	R4, R6 22K
C5 .01 μ F	R7 150K
VR1 10K	Q1 medium gain NPN
VR2 47K	IC1 556 dual timer

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Document Those Variables

William Noel
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You've just received someone's advanced Star Trek game and want to soup it up a little or maybe update it to the movie version. Now comes the tedious part. You must sift through the program trying to figure out how and what variable names are used.

One long night I sat peering at the screen with bloodshot eyes trying to shift @ the program

list, while trying to remember what had disappeared ten lines ago. Either inspiration or desperation hit me: Why not get my TRS-80 to help with this lengthy effort?

Program Text Area

First, I had to figure how the information was coded in the BASIC text area. Program Listing 1 helps examine this area of memory. It begins at location 17129, where the memory contents are PEEKed and printed. If the memory byte contains a normal screen character, this sym-

bol is also shown.

After much trial and error in analyzing memory displays I have discovered that the first two positions of each line point to the memory location beginning the next line. The BASIC interpreter can use this, for exam-

ple, to avoid the delay of trying to decode remark lines during a program run.

The third and fourth locations represent the line number itself. Table 1 shows this coding for the first two lines of our memory display program.

```
65000 A$ L M N A$ C S
65005 D T D T D E T E T E J T S F E E
65010 D U Z S S U U
65012 D U U U Z S S T
65015 F Z Z
65020 F Z U D
65030 W Z W
65040 W Z W
65050 W
65060 Z J
65080 Z J
65090 J
65100 Z Z
65110 Y$ Z S S S S S
65120 Y$ Y$ S T Y$ Y$ T
65140 Y$ F A
65150 A$ A Y$
65160 A$ A Y$
65170 B C A
65180 A$ B A$ B L B L B M B M B N B N B B
65190 C C C
65200 A$ A Y$ L A E M A E N A
65210 M A E M A E N A N A
65220 A
65230 A
65240 A C
65250 A$ A L A M A N A K K K K K
65260 A
65270
65280 T U U U
```

Fig. 2. Variable Hunt.

```
1 CLS
5 I = I + 1
10 H = PEEK(17129 + GG)
20 GG = GG + 1
30 PRINT H; " ";
40 IF H > 31 AND H < 91 THEN PRINT CHR$(H), ELSE PRINT "",
50 IF I = 60 INPUT Q: I = 0
60 GOTO 5
```

Listing 1.

239	66	B	1	0
132	0		250	66
5	0		73	I
213	73	I	205	49
0	14		67	C
0	72	H	32	213
32	229		40	(
55	49	1	50	2
205	71	G	71	G
0	26		67	C
0	71	G	71	G
71	71	G	205	49
0	40	(	67	C
0	178		32	72
59	34	"	32	32
?				
34	59	;	0	76
67	40	(	0	143
32	72	H	212	51
49	32		210	32
72	214		57	9
32	202		32	178
32	247		40	(
41	44	,	32	72
149	32		178	58
34	44	,	0	34
67	50	2	0	96
32	73	I	213	143
48	32		137	54
81	58	:	32	32
213	48	0	0	73
?				104
67	60	<	0	141
32	53	5	0	0
0	4		0	73
				I

Fig. 1. Out of Memory Display.

Listing 2.

```

65000 'RESET BEGINNING OF TEXT & DEFINE TABLE'
      POKE 16548,233:POKE 16549,66:CLS:DIM AS(
        100), L(100), M(100), N(100):AS(1)="":C=1:S=1
65005 'GET NEXT LINE, THIS LINE, PRINT, AND CHECK IF THROUGH'
      GOSUB 65280:D=T:GOSUB 65280:D=T*256+D:GOSUB 65280:
      E=T:GOSUB 65280:E=T*256+E:PRINT":PRINT E;J=0:
      T=1:S=1:F=0:IF E=65000 GOTO 65240
65010 'FINISH LAST CHARACTER OF TEXT LINE'
      IF D=17129+U THEN Z=S:S=1:U=U+1:GOTO 65015
65012 'CHECK IF LINE HAS ENDED; OTHERWISE GET NEXT LOCATION'
      IF D=17128+U THEN U=U+1:GOTO 65005:ELSE Z=S:S=T:
      GOSUB 65280
65015 'IF LONG VARIABLE NAME, SKIP REST'
      IF F=1 AND Z>64 AND Z<91 GOTO 65010
65020 'WHEN A REMARK COMMAND, JUMP TO NEXT LINE'
      F=0:IF Z=147 THEN U=D-17129:GOTO 65005
65030 'BEGIN SKIP OF CHARACTERS FOLLOWING A '
      IF W=0 AND Z=34 THEN W=1:GOTO 65010
65040 'END SKIP WHEN THE 2ND " IS REACHED'
      IF W=1 AND Z=34 THEN W=0:GOTO 65010
65050 'SKIP CHARACTERS BETWEEN'
      IF W=1 GOTO 65010
65060 'WHEN : IS REACHED, RESET THE DATA COMMAND SKIP'
      IF Z=58 THEN J=0
65080 'SET TO SKIP IF A DATA COMMAND'
      IF Z=136 THEN J=1
65090 'DATA COMMAND SKIP'
      IF J=1 GOTO 65010
65100 'ALLOW ONLY LETTERS IN 1ST CHARACTER'
      IF Z<65 OR Z>90 GOTO 65010
65110 'BUILD 1ST LETTER, CHECK IF VALID 2ND CHARACTER'
      Y$=CHR$(Z):IF (S<48 OR S>57) AND (S<65 OR S>90) AND
      S<>36 GOTO 65140
65120 'ADD 2ND CHARACTER, ADD 3RD CHARACTER IF $ '
      Y$=Y$+CHR$(S):IF T=36 THEN Y$=Y$+CHR$(T)
65140 'PRINT VARIABLE AND BEGIN TABLE SEARCH'
      PRINT Y$;" ";F=1:FOR A=1 TO 100
65150 'TRY AGAIN IF VARIABLE NOT YET REACHED'
      IF AS(A)<Y$ GOTO 65230
65160 'FIND THE MATCHING VARIABLE'
      IF AS(A)=Y$ GOTO 65210
65170 'BEGIN SHIFT TO MAKE ROOM FOR NEW VARIABLE'
      FOR B=C TO A STEP-1
65180 'SHIFT OVER 1 WORKING RIGHT TO LEFT'
      AS(B+1)=AS(B):L(B+1)=L(B):M(B+1)=M(B):N(B+1)=N(B)
      :NEXT B
65190 'INCREASE TABLE ENTRY COUNT AND CHECK IF OUT OF ROOM'
      C=C+1:IF C=100 STOP
65200 'INSERT NEW VARIABLE'
      AS(A)=Y$:L(A)=E:M(A)=E:N(A)=1:GOTO 65220
65210 'WHEN THE SAME VARIABLE, UPDATE FOR THIS LINE'
      IF M(A)<>E THEN M(A)=E:N(A)=N(A)+1
65220 'CAUSE AN EARLY END TO THE TABLE SEARCH'
      A=100
65230 'CONTINUE TABLE SEARCH OR GET NEXT TEXT POSITION'
      NEXT A:GOTO 65010
65240 'BEGIN DISPLAY OF VARIABLE SUMMARY'
      PRINT":FOR A=1 TO C-1
65250 'PRINT SUMMARY AND WAIT IF A FULL SCREEN'
      PRINT AS(A),L(A),M(A),N(A);:K=K+1:IF K=15 THEN
      INPUT R:CLS:K=0
65260 'PRINT THE NEXT LINE'
      NEXT A
65270 END
65280 'GET THE CURRENT POSITION OF TEXT & MOVE COUNTER TO NEXT'
      T=PEEK(17129+U):U=U+1:RETURN

```

Note: Up arrow appears as left bracket in listings.

Note: Line 65005 allows the program to run independently.

As you can see, the line number code has the least significant value first. This seemingly backwards way of coding is the manner the TRS-80's microprocessor handles two-byte numbers.

Look a little closer at the next line pointer which also has this reverse sequence.

A byte, of course, has eight bits that can be turned either off or on representing either zero or some numeric value. A code of two bytes gives a total of 16 bits to represent a memory address in the next line pointer's case.

Each of these 16 bits are numbered 0-15 and represent, when on, a value based upon their location number. Beginning with bit 0 having a value of $1(2^0 = 1)$, two is multiplied times the prior bit value. These values are shown in Table 2.

Looking at byte 1, you can create total values from 0 to 255 by adding different bit combinations. This matches the range of values generated by PEEKs into memory. After looking at both bytes together in this manner, it is easy to see why the first byte should represent the low order value.

Adding all 16 of these bit values together results roughly in the largest memory value and line number that can be represented in two bytes. This figure totals to 65535.

When I say it is a rough maximum, I am referring to the line number. For some reason that I have yet to find, we are restricted to an upper line number limit of 65529, although the coding possibilities will allow six more. But who's going to need them with over 65000 available?

Of course, in BASIC we must deal with one byte at a time while using the PEEK statement. It is possible to convert the second byte to its proper value by multiplying it by 256.

Convert line one's next line pointer:

$$239 + (66 \cdot 256) = 17135$$

This result matches the first memory byte of line five.

Text Coding

Fig. 1 shows the complete text area for the memory display program. The variables I, H, GG, and Q are kept in normal screen and keyboard coding.

But the statements and functions CLS, PEEK, PRINT, IF, AND, ELSE, INPUT, GOTO, =, +, >, <, CHR\$ have all been converted to a one-character special code.

This conversion in addition to saving memory also makes it easier to identify program variable names. PEEK won't be confused with the variable name PE. The same is true of other statements and variables.

Listing 2 shows a program that picks out variables. At the same time the program saves the first line number, last line number, and number of total line occurrences for each variable.

When a program line contains a remark, everything following it will be ignored by Level II machines. When you enter these program lines, either leave out the remarks or enter them at different line numbers.

Figs. 2 and 3 show the screen results of this program analyzing itself. Fig. 2 shows the program as it progresses through the text identifying each line and the variables found in that line. Fig. 3 shows the screen summary displayed when that run is finished.

Table 3 defines each variable used in the variable documentation program.

Now that we have a program that documents variables, another bothersome detail crops up. This program must be in the same text area as the program it will analyze.

The July, 1979, issue of Radio Shack's *Microcomputer Newsletter*, includes a method for adding a BASIC program by keying it in at the end of existing text contents. The flowchart in Fig. 4 shows the steps involved.

After trying it a few times, I looked for an easier way. What was this PEEKing and POKEing really accomplishing?

With our knowledge of the coding technique for current line number and next line location, let's convert the last two

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N	65000	65250	5
R	65250	65250	1
S	65000	65120	6
T	65005	65280	4
?			
U	65010	65280	4
W	65030	65050	3
Y\$	65110	65200	6
Z	65010	65110	10

Fig. 3. Variable Summary.

Line Number	Next Line Pointer	Current Line Number	Line Program Statements	Trailing Character
1	Memory			
	Location: 17129 30	31 32	33	34
	Value: 239 66	1 0	132	0
	Character: B			
5	Memory			
	Location: 17135 36	37 38	39 40 41 42 43 44	45
	Value: 250 66	5 0	73 32 213 73 205 49	0
	Character: B		I Space I 1	

Table 1. First two lines of Memory Display Program.

Byte	Bit No.	0	1	2	3	4	5	6	7
1:	Value	1	2	4	8	16	32	64	128
2:	Bit No.	8	9	10	11	12	13	14	15
	Value	256	512	1,024	2,048	4,096	8,192	16,384	32,768

Table 2. Two Byte Numbers.

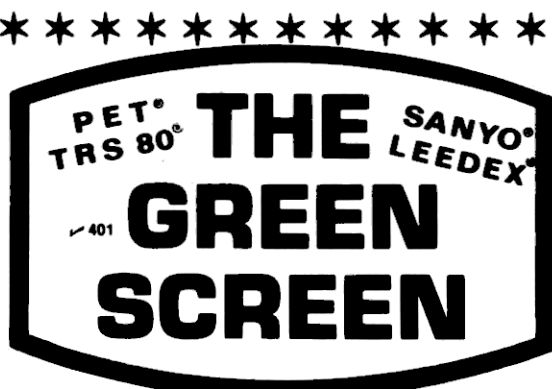
A	Counter for table search
A\$	Table for variable name
B	Present location during table shift
C	Pointer for last table entry
D	Next line beginning memory address
E	Current line number
F	Switch to skip rest of long variable name
J	Switch to skip after DATA statement
K	Line count for screen summary
L	Table for first line occurrence
M	Table for last line occurrence
N	Table for number of total line occurrences
R	Fake input variable
S	Next to oldest text character (1 ago)
T	Current text character
U	Counter for current position in text
W	Switch to skip from first "to 2nd"
Y\$	Current variable name
Z	Oldest text character (2 ago)

Table 3. Variable List.

Line number	Change
65000	delete the two POKES
65010	change 17129 to 26302
65012	change 17128 to 26301
65020	change 17129 to 26302
65280	change 17129 to 26302

Then type SAVE "VARDOC,"A

Table 4. Program Changes for Disk BASIC.



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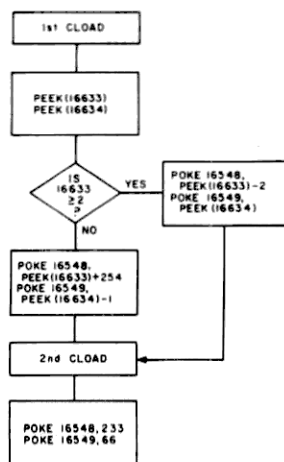
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Flow Chart.

POKES to

$$233 + (66 \cdot 256) = 17129$$

Voila! That is the beginning text memory location we have been using. Therefore, locations 16548 and 16549 must be where Level II BASIC keeps this pointer.

The comparison of location 16633 to 2 and the two POKES on either route afterwards, are going to be a little more difficult to decipher.

If you have the two-byte number 167 and want to subtract 2 from it, you run into trouble right away. One minus 2 gives -1, which isn't within the 0-255 code range. So borrow 1 from the second byte making it 66 and add its multiplied value $1 \cdot 256$ to the first byte. This manipulation gives you the number 257 66. Now subtract 2, giving 255 66.

If the first byte were 2 or larger, you wouldn't have to borrow from the second. Two minus 2 gives 0 which is a valid result.

Suppose, somewhere in memory, Level II BASIC keeps track of the memory location that follows the last program line. It could then point two bytes beyond the final program line.

Double VOILA!! The beginning of text pointer (locations 16548 and 9) is replaced with the position new text should begin (locations 16633 and 4 minus 2). When this is done, Level II BASIC is tricked into loading a new program after the current

text program. Finally, the beginning text pointer must be reset back to the correct value of 17129.

Assembler Help

Program Listing 4 shows an assembler program which replaces the beginning text pointer. The decision-element (DE) register pair is loaded with the value 2 while the HL register pair is loaded with the hexadecimal address of the end of text pointer.

The DE pair is subtracted from this address, and any borrowing is automatic. It then stores this adjusted value in the hexadecimal address of the beginning text pointer and jumps to the Level II READY message.

This program loads just below Radio Shack's debounce routine on a 16K system.

The beginning text pointer is then reset to its correct value by the two POKES in line 65000 as shown in Program Listing 2.

The steps to run variable documentation are:

1. CLOAD the program to be analyzed.
2. Enter SYSTEM, ADDTXT and / (or follow the steps in Fig. 4).

3. CLOAD the variable documentation program in Program Listing 2.
4. Enter RUN 65000.

If the screen becomes completely full during the summary display, hit ENTER to continue.

To run variable documentation with Disk BASIC, make the program changes shown in Table 4.

The execution steps are 1) LOAD the program to be analyzed; 2) enter MERGE "VAR-DOC"; and 3) enter RUN 65000.

There are several things that could cause complications in running the variable documen-

tation program. Remember that the program to be analyzed should not have lines numbered 65000 or greater.

Program tables allow only 99 entries. They must be increased to record more variable names. Also the CLEAR must be increased correspondingly. These changes will naturally use more memory.

If there is not enough memory to do the run, delete the following from the program to be analyzed:

- REM lines
- Lines that don't have variables
- DATA statements
- Characters between double quotes

If you want a printout of the summary, insert the following program line:

65255 LPRINT A\$(A), L(A), M(A), N(A)

Saving Memory

Understanding how program lines are coded in the text area makes it easier to see what to avoid for programs tight on memory. Remember that spaces in the text line use one byte each; each program line adds five bytes (VS one byte for a.); and REM lines use a full byte for each comment character. It is better to choose single-letter variable names than two character names.

Now that you have a program and an understanding of how to document variables, how about a challenge? Who out there can develop a program to effectively document GOTOs, GOSUBs, and RETURNS?■

```

65000 POKE16548,233:POKE16549,66:CLR200:CLS:DIMA$(100
),L(100),M(100),N(100):A$(1)="":C=1:S=1
65005 GOSUB65280:D=T:GOSUB65280:D=T*256+D:GOSUB65280:E=
T:GOSUB65280:E=T*256+E:LPRINT":J=0:T=1:S=1:F=0:IF
E=65300GOTO65240ELSELPRINT:
65010 IFD=17129+UTHEZ=S:S=1:U=U+1:GOTO65015
65012 IFD=17128+UTHEZ=U-1:GOTO65005:ELSEZ=S:S=T:GOSUB6
5280
65015 IFZ=1ANDZ>64ANDZ<91GOTO65010
65020 F=0:IFZ=147THENU=D-17129:GOTO65005
65030 IFW=0ANDZ=34THENW=1:GOTO65010
65040 IFW=1ANDZ=34THENW=0:GOTO65010
65050 IFW=1GOTO65010
65060 IFZ=58THENJ=0
65080 IFZ=136THENJ=1
65090 IFJ=1GOTO65010
65100 IFZ<65ORZ>90GOTO65010
65110 Y$=CHR$(Z):IF(S<48ORS>57)AND(S<65ORS>90)ANDS<>36G
OTO65140
65120 Y$=Y$+CHR$(S):IFT=36THENY$=Y$+CHR$(T)
65140 LPRINTY$:" ":F=1:FORA=1TO100
65150 IFAS(A)<Y$GOTO65230
65160 IFAS(A)=Y$GOTO65210
65170 FORB=CTOASTEP-1
65180 AS(B+1)=AS(B):L(B+1)=L(B):M(B+1)=M(B):N(B+1)=N(B)
:NEXTB
65190 C=C+1:IFC=100STOP
65200 AS(A)=Y$:L(A)=E:M(A)=E:N(A)=1:GOTO65220
65210 IFM(A)<>ETHENM(A)=E:N(A)=N(A)+1
65220 A=100
65230 NEXTA:GOTO65010
65240 STOP:LPRINT":FORA=1TOC-1
65250 LPRINTA$(A),L(A),M(A),N(A):K=K+1:IFK=15THENINPUTR
:LPRINT"?":LPRINT":LPRINT":LPRINT":LPRINT":
CLS:K=0
65260 NEXTA
65270 END
65280 T=PEEK(17129+U):U=U+1:RETURN
65300 REM
  
```

Listing 3.

7FBA	00100	ORG	7FBAH	;BEGIN AT 32698
7FBA	110200	LD	DE,2	;LOAD IN 2
7FBD	2AF940	LD	HL,(40F9H)	;LOAD CONTENTS OF 16633 & 4
7FC0	ED52	SBC	HL,DE	;SUBTRACT 2
7FC2	22A440	LD	(40AAH),HL	;LOAD RESULT IN 16548 & 9
7FC5	C3191A	JP	1A19H	;JUMP TO READY MESSAGE
7FBA	00150	END	BEGIN	
00000	TOTAL ERRORS			

Listing 4.

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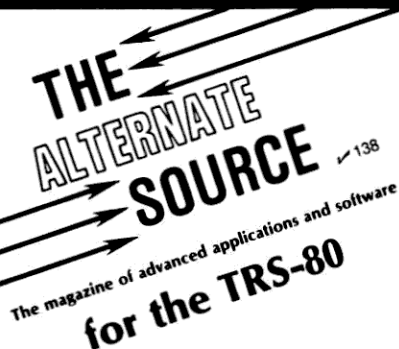
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Printer Calibration

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If you use more than one type of paper with your printer, this simple modification makes a lot of sense.

At the office my TRS-80 and Centronics 779 with tractor feed are used primarily for handling advertising mail inquiries and our normal operation uses five different types of forms.

In the interest of saving time and improving efficiency, the need for a method that starts every print routine exactly where it is intended, regardless of who is operating the system, was apparent.

Three Variables

With the Centronics 779, three variables are of primary importance in printing a professional looking form: left margin setting, top-of-form setting and the "density" setting. Any, or all of these, may require different

settings for various print routines or form sizes. The length of form (number of lines) is not included, since a program is usually written with this factor as a constant.

The simplest variable is the left margin setting. The printer's roller/tear-bar assembly has an engraved scale in one-eighth-inch increments from -15 on the left to 90 on the right. This scale should be used to set the left edge of the form to be printed. The value is determined by a trial run.

To set the top-of-form requires the addition of a scale to the 779. This is done quite easily if you use the hold down clamp on the left pin feed assembly. As shown in Photo 1, use a three and one-half-inch peel-off label and type a column of numbers, say, from 1 to 21. Trim off the excess margins and place the label right along the edge of the hold down clamp. The resultant scale now allows you to set the top-of-form to a specified position.

The third variable is the print

density control. This sets the number of characters-per-inch printed. For maximum legibility you usually want this set as wide as the form will allow. The control, located on the rear of the printer, is not only difficult to reach but requires several lines of print, with trial and error adjustments, to get the optimum settings. A calibrated dial knob solves this problem easily.

The dial knob I used is Radio Shack's part no. 274-413. However, on some printers, the shaft may not protrude quite far enough to get a good bite when the set screw is tightened. If so, use a coarse file on the rear face of the knob, removing about 1/32 of an inch to 1/16 of an inch.

Cut a sliver from the adhesive-backed label to make a pointer for the dial and place it approximately as shown (Photo 2). Rotate the adjustment shaft fully counterclockwise (lowest density setting) and push the knob onto the shaft, setting the number one mark to the arrow. Tighten the set screw and you're through.

Find Your Values

Run each of your print routines and determine the optimum value of the three variables: left margin, top-of-form and density. Note these values for use with the routines. The best place to note them is in your program, immediately preceding the first LPRINT statement. If you are new to programming, here is the statement I use to get the results shown in Photo 3 (your line number, title and values will relate to your own program, of course):

```
1000 CLS:PRINT @320, "READY TO PRINT
MAILING LABELS DIRECTLY FROM
DISC":PRINT:PRINT:"SET TOP-OF-
FORM TO 20":PRINT:"SET LEFT
EDGE OF FORM TO -4":PRINT
"SET DENSITY CONTROL TO 4":
INPUT "ENTER TO CONTINUE":X
```

When LLISTING a program in BASIC, it is not possible to use such a prompting message, and I am constantly LLISTING with the density set too low, which results in my losing the ends of long program statements. As a reminder to myself to set the density before starting a LLIST, I

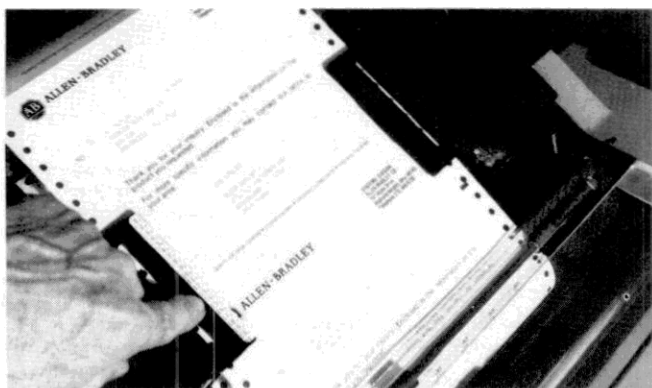


Photo 1

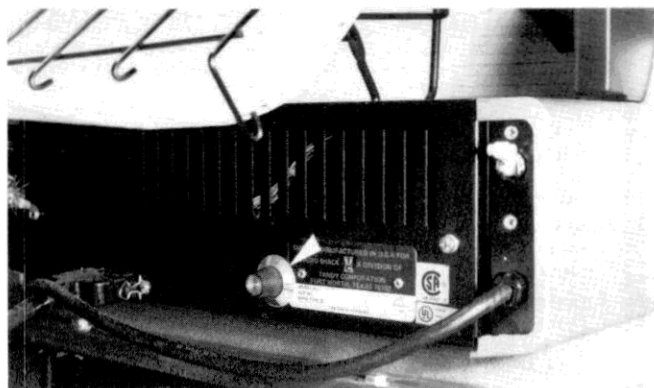


Photo 2

READY TO PRINT MAILING LABELS DIRECTLY FROM DISC

SET TOP-OF-FORM TO 20
SET LEFT EDGE OF FORM TO -4
SET DENSITY CONTROL TO 4
'ENTER' TO CONTINUE? _

Photo 3

used another label, placed prominently on the top front of the printer that almost shouts, "For Listings Set the Density to 7 inches. It works."

We have been using this method for several months now, and it is quite gratifying to see the results. No matter who is operating the system, and regardless of how often we change forms or paper, the first line of print goes down exactly where we want it to.

A couple of other time savers we have added to our program are worth the time and the slight additional memory required. The first one resulted from our operator having spent over an hour trying to figure out why the computer wouldn't run and finally realizing that the "out of paper switch was off, due to a small tear in the form which wasn't readily apparent.

To prevent this from happening again, I added a GOSUB in

front of every LPRINT statement. The subroutine checks the status of both the "out of paper switch and the print switch. If either is off, a prompting message is displayed telling the operator what is wrong and allowing him to correct before continuing. My subroutine reads as follows:

```
750 IF PEEK(14312) < 128 RETURN ELSE 751
751 CLS:PRINT @ 468,"PRINTER NOT
READY":PRINT @ 583,"R"—RETURN
TO MENU "O"—OK TO CONTINUE"
752 QS=INKEY$:IF QS="R" THEN 511
753 IF QS="O" THEN RETURN
```

of adding the up arrow as the selection to advance one line and adding the letter "T" to go to top-of-form. I did not include these two symbols in the menu table to prevent clutter. They are blind selections. Here are the routines:

```
620 IF QS="↑" THEN 800
625 IF QS="T" THEN 810
```

```
800 IF PEEK(14312) < 128 GOTO 805 ELSE
511
805 POKE 16424,1:POKE 16425,0:LPRINT
CHR$(11):GOTO 511
810 IF PEEK(14312) < 128 GOTO 815 ELSE
511
815 POKE 16424,51:POKE 16425,0:LPRINT
CHR$(11):GOTO 511
```

This simple solution has saved us hours.

Add Top-of-form

Since the 779 doesn't have front panel controls that allow either a line feed or a top-of-form, I added these as a part of my program. Since each program has a menu, this was the obvious place to access these routines.

The menu uses the INKEY\$ function, so it was just a matter

In either of these routines, if the printer is not ready, nothing happens except returning you to the menu. The ↑ advances the paper one line. The T advances the paper 51 lines, then you are returned to the menu.

In all the examples given, my menu routine begins at line 511. ■

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I don't know about you, but for me the greatest joy from my computer comes during the development of some useful software. Each time I write a new program I try to be more creative, using lessons learned from past programs plus new techniques and subroutines that I've run across in the many magazines and club newsletters that I read.

Advancing from SET (X,Y) graphics to POKE and then string-packing techniques, you also advance in the artful use of BASIC. It's a very satisfying experience.

More Elegant INPUT

So with this noble goal in mind I decided to come up with an alternative to the INPUT statement. What originally prompted me to do this was my desire to have the majority of the screen "painted" white, with only a block of darkness in the center where input questions or prompts would appear.

With the INPUT statement, after typing in the data, you would hit ENTER, at which time the rest of the line (which I wanted to keep white) would be erased. Not only that, but I wanted a blinking cursor along

with other automatic features I'll describe later.

Another negative aspect of the INPUT statement is that you can't enter commas and other string delimiters. Disk BASIC gives the LINE INPUT statement which solves that problem, but it's still basically the old inelegant INPUT statement.

The resulting input subroutine was developed and its first application was in a program for recording customer sales data for my own company.

The overall scheme uses an input subroutine to enter data into a temporary array I(EC). During the course of a single pass through the subroutine, I use 14 variables in array I(EC). I'll call these variables INPUT LINES I(EL).

After completing a pass through the input subroutine, the contents of I(EC) will be transferred to a master array for later output to tape or disk. Following this transfer, all the elements of I(EC) will be nulled (I(EC) = "") and the program will return to the beginning of the INPUT subroutine for new customer data.

After initialization, I run a program called Screen that creates and stores various graphic forms that will be recalled in the subroutine as well as other parts of Customer Sales Program, using the GSF Package by Racet Computes. One of GSF's many features is the ability to store a display in protected memory, so that it can be recalled by a simple BASIC state-

ment.

At the end of Screen program I have the statement RUN SALES/BAS, which loads and runs the Customer Sales Program. This is where the INPUT subroutine comes in.

For purposes of this article I've added lines 1000 to 1020 to create a simple version of the graphic display used during data input.

The Subroutine

Line 20 clears 1000 bytes of string space and predefines the variables used as string or integer. Array I(EL) is dimensioned to hold 14 data items, and array S(N,X) is dimensioned for 20 customers.

Line 30 calls or creates a screen print routine. You can paint your screen however you like. For demonstration purposes, I'll use the subroutine at line 1000 for screen painting.

In line 100 PC% stands for the blinking cursor. Initially it's set equal to 32, which when inserted into a PRINT CHR\$(PC%) statement prints a blank space. I'll discuss the cursor further at line 130. EL is the subscript for array I(EL) and is initially set for INPUT LINE #1 [I(1)].

Line 110 is the FOR-NEXT loop that makes the whole thing work. Each I(EL) has a number, 1 to 14. The first time through the program, EL = 1. Therefore, the FOR-NEXT loop reads EP (EP = "print @ location" where I want the cursor to begin) and ES (ES = maximum number of characters allowed for an input line).

As the program progresses EL increments, or decrements. The FOR-NEXT loop rereads DATA lines 270-275 ending up with EP and ES equal to the correct data for I(EL).

RESTORE enables you to start from the beginning of the DATA line for each READ session. EZ counts the number of spaces over from the original position (EP). Initially it's set to zero.

The PRINT@ EP statement prints a string of blanks equal to the maximum number of characters (ES) allowed for that line. This is my way of clearing the line without erasing any of the white boundary.

Each I(EL) is defined below:

I(1) — customer number (3 characters)
I(2) — customer name (20 char.)
I(3) — customer business name (20 char.)
I(4) — address line 1 (20 char.)
I(5) — address line 2 (20 char.)
I(6) — address line 3 (20 char.)

The remaining lines are for customer phone numbers.

I(7) and I(11) — "H" for home or "W" for work (1 char.)
I(8) and I(12) — area code (3 char.)
I(9) and I(13) — 3-digit prefix (3 char.)
I(10) and I(14) — 4-digit number (4 char.)

As you can see, each phone number is made up of four separate variables. The reason for this is to allow for punctuation during data input, and yet end up with a single variable for each phone number containing no punctuation (or at least limited to 11 characters).

Later, in line 290 each set of

four variables is added together to create these two phone number variables [I(7) and I(11)].

In line 120 when EL is equal to, or greater than 7, this statement POKES the necessary punctuation to the screen for the phone numbers. Since line 120 is within the main FOR-NEXT loop this punctuation will remain on the screen for the duration of the telephone number input.

The INKEY\$ Loop

Line 130 is very important. It starts the INKEY\$ loop. PC% = 175 - PC% creates a blinking cursor.

You'll recall that in line 100 PC% was set equal to 32. During the first pass of the INKEY\$ loop, PC% becomes equal to 143. This is a graphic block when used in a PRINT CHR\$(PC%) statement. The next time line 130 is executed, PC% equals 32 again, resulting in a blank and so on. Voilà—a blinking cursor!

The statement PRINT @ EP + EZ, CHR\$(PC%) therefore prints the cursor at (EP + zero) the first time, then EZ increments or decrements as characters are entered.

Lastly there's the statement I = INKEY\$ which scans the keyboard setting string variable I equal to whatever the keyboard sees.

In line 140, PEEK (14400) and (14464) check to see if both the shift key and ← are pressed. If they're both down, the program branches to LINE 280.

If both keys are down the cursor will move backward erasing characters from the screen and memory. If you continue to hold the keys down, they act like a repeat key.

This is the only occasion where I PEEK the keyboard memory for control keys. For the remaining control keys I test the ASCII value of I [ASC(I)], for reasons you'll see later.

Line 150, as with any INKEY\$ statement, tests for no key being depressed, in which case the INKEY\$ loop is repeated. This no-key test must come before you test for the ASCII value of string variable I, because if I is null, you'll get an FC ERROR. On

the other hand, it must come after the statement in line 140 in order to get the repeat backspace.

Line 160 checks the cursor character. If it's the graphic block, a blank gets printed in its place. This eliminates a possible stray cursor after hitting ENTER, CLEAR, ←, etc.

Lines 170 to 230 check to see if the key being depressed is a control key. These keys are SHIFT/E, SHIFT/S, CLEAR, ←, ↑ and ENTER. I test for the ASCII value, since it gives a single discrete value for individual keys or any combination of keys.

While writing this program I used a subroutine in line 9000: I\$ = INKEY\$: IF I\$ = "" THEN 9000 ELSE PRINT @ 0, I\$, ASC(I\$); GOTO 9000. Every time I wanted to find out the ASCII value of a key or combination of keys, I'd run line 9000.

In line 170 if EL is greater than 6, we must be in the telephone number segment of the program. At that point, if SHIFT and the S key are held down, the program won't enter that particular set of four phone number variables. Instead it goes to the next phone number, or, if it happens to be skipping the second and last phone number entry, it

branches to line 290, where the phone numbers are assembled.

Starting Over

At line 180 if ASC(I) = 32, you've hit the CLEAR key, indicating that you want to erase the line and start over. A string of blanks is printed at the cursor starting position (EP) for that time. The number of blanks is the same as the maximum number of characters allowed (ES). EZ is set to zero, and the temporary input, I(EL), is nulled. Note that EL stays the same.

At line 190 if ASC(I) = 8, you've hit the ← causing the cursor to backspace one step and

```

20 CLEAR (1000) : DEFINT E,N : DEFSTR I,P,Q,S,T : CLS : DIM I(15), S(20,8)
30 CLS : GOSUB 1000 : REM *** CREATE OR RECALL SCREEN DISPLAY HERE ***
100 PC% = 32 : EL = 1
110 RESTORE : FOR EC = 1 TO EL : READ EP,ES : NEXT : EZ = 0 : PRINT @ EP, STRING$(ES,32);
120 IF EL > 6 POKE 15833,62 : POKE 15837,45 : POKE 15841,45 : POKE 15897,62 :
    POKE 15901,45 : POKE 15905,45 : PRINT @ 599, " HOME OR WORK";
130 PC% = 175 - PC% : I = INKEY$ : PRINT @ EP + EZ, CHR$(PC%);
140 IF PEEK(14400) = 32 AND PEEK(14464) = 1 GOTO 280
    REM *** SHIFT/LEFT ARROW = REPEAT BACKSPACE ***
150 IF I = "" GOTO 130
160 IF PC% = 143 PRINT @ EP + EZ, CHR$(32);
170 IF (EL > 6) AND (ASC(I) = 115) THEN IF EL = 7 THEN EL = EL + 4 : GOTO 110 ELSE GOTO 290:
    REM *** SHIFT/S TO SKIP PHONE NUMBER ***
180 IF ASC(I) = 31 PRINT @ EP, STRING$(ES,32); : I(EL) = "" : EZ = 0 : GOTO 130 :
    REM *** CLEAR KEY = ERASE AND START OVER ***
190 IF ASC(I) = 8 GOTO 280 : REM *** LEFT ARROW = SINGLE BACKSPACE ***
200 IF ASC(I) = 91 THEN EL = EL - 1 : I(EL) = "" : PRINT @ EP, STRING$(ES,32); : GOTO 110 :
    REM *** UP ARROW = REDO LINE ABOVE ***
210 IF ASC(I) = 13 THEN PRINT @ EP, I(EL) + STRING$(ES - LEN(I(EL)) + 1, 32); : EL = EL + 1 :
    IF EL < 15 GOTO 110 ELSE 290 : REM *** ENTER KEY = SAVE ENTRY ***
220 IF ASC(I) < 32 GOTO 130
230 REM *** RESERVED FOR SHIFT/E = EDIT MODE ROUTINE ***
240 IF EZ < ES THEN I(EL) = I(EL) + 1 : EZ = EZ + 1 : PRINT @ EP, I(EL); : GOTO 130
250 IF EL < 7 THEN 130 ELSE IF EL < 14 THEN PRINT @ EP, I(EL); : EL = EL + 1 : GOTO 110
260 GOTO 290
270 DATA 88,3,152,20,216,20,280,20,344,20,408,20,472,1,474,3,478
275 DATA 3,482,4,536,1,538,3,542,3,546,4
280 IF EZ > 0 THEN I(EL) = LEFT$(I(EL), EZ - 1) : PRINT @ EP + EZ - 1, STRING$(ES - EZ + 2, 32); :
    EZ = EZ - 1 : GOTO 130 : ELSE GOTO 130
290 I(7) = I(7) + I(8) + I(9) + I(10) : I(11) = I(11) + I(12) + I(13) + I(14)
300 FOR X = 1 TO 7 : S(N,X) = I(X) : NEXT : S(N,X) = I(11) : CLS :
    FOR X = 1 TO 15 : I(X) = "" : NEXT : N = N + 1 :
    CLS : PRINT @ 320, "TO CONTINUE ENTERING DATA [ENTER C]" :
    INPUT "TO PRINT IT OUT [ENTER P]"; Q : IF Q = "C" GOTO 30
305 FOR X = 0 TO N - 1 : FOR E = 1 TO 8 : PRINT "ENTRY:"; X + 1, "ITEM:"; E, S(X,E) : NEXT E :
    PRINT STRING$(60,42) : NEXT X : END
1000 T1 = STRING$(22,191) : T2 = STRING$(24,128) : T3 = STRING$(18,191)
1010 PRINT STRING$(64,191); : FOR X = 1 TO 9 : PRINT T1 + T2 + T3; : NEXT : FOR X = 1 TO 5 :
    PRINT STRING$(64,191) ; : NEXT
1020 RETURN

```

Program Listing.

erase the last character. The erasing is done by a branch to line 280.

At line 200 if $ASC(I) = 91$ you hit $\uparrow$. This means you want to erase the line above. I put this in the program in the event you prematurely hit ENTER.

Line 210 responds to ENTER by processing the data contained in $I(EL)$. First, $I(EL)$ plus some cleanup blanks are printed at the proper location (EP). Subscript EL is incremented by one in preparation for entering the next INPUT line [$I(EL + 1)$].

If EL is less than 15 then the program branches to line 110 to begin entering the new $I(EL)$. However, if EL is greater than 15, then all $I(EL)$ have been entered and we branch to line 290 to complete data processing.

Line 220 acts as a protection against entering certain TRS-80 control characters. Refer to page C1 of the Level II manual.

Line 230 is reserved for my SHIFT/E, edit/correction sub-

routine. Normally, it would say "IF $ASC(I) = 101$ GOTO ... the editing subroutine."

At line 240 if the number of characters in $E(EL)$ is less than the maximum number allowed (ES), then the new character (I) is concatenated to the tail of $I(EL)$. Since $I(EL)$ is now longer by one character, EZ is incremented by one. Then $I(EL)$ is printed at EP. This completes the INKEY\$ loop so the program returns to line 130.

If, in the above line EZ equals ES, then the program drops to line 250. You won't be able to add any more characters to $I(EL)$. However, if you're working on INPUT lines 7 through 13, the second half of line 250 comes into play. Basically, whatever you type after each of the four elements of the phone number will trigger an advance to the next input line.

Line 260 lets you jump over line 280.

Lines 270 and 275 are the DATA statements for reading in line 110.

Testing the Cursor

The first instruction in line 280 tests whether the cursor can move any further to the left. You'll recall that EZ increments every time the cursor moves to the right of the original starting position. As long as EZ is greater than zero, there's room to move backwards or left. If EZ is greater than zero then the backspacing and erasing occurs.

This is accomplished by the statement $I(EL) = LEFT$(I(EL), EZ-1)$ which chops off the last character in string $I(EL)$. The new value of $I(EL)$ is printed, followed by a string of blanks equal to the maximum string length (defined by ES), minus the length of $I(EL)$. The blanks are for erasing the rest of the line.

The new cursor position becomes EZ minus one, then the program returns to line 130.

Line 290 combines the four telephone number variables into two master variables ($I(7)$ and $I(11)$).

Lines 300, 305 and 1000 through 1020 are included in order to make the program work for demonstration purposes.

Data is processed in line 300. The contents of the eight temporary storage variables ($I(1)$ through $I(7)$ and $I(11)$) are transferred to permanent storage in two-dimensional array $S(N,X)$.

Line 305 prints out the contents of array $S(N,X)$.

Lines 1000 through 1020 simply create a screen image.

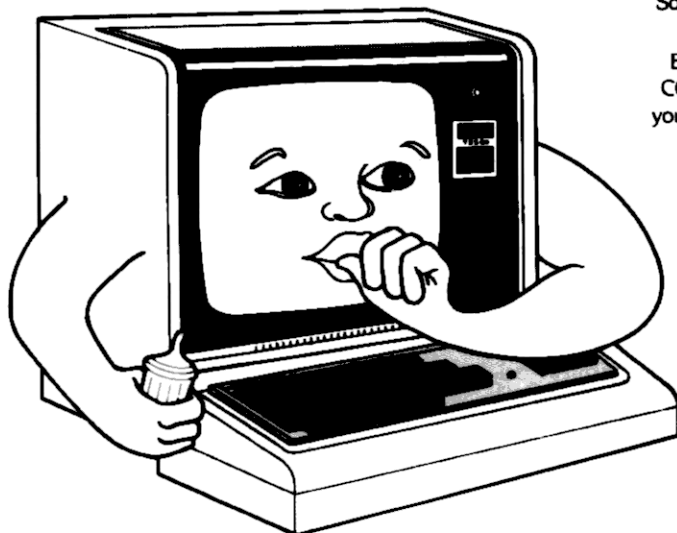
In my Customer Sales Program line 300 is the beginning of the error correction and editing subroutine mentioned in line 200. Following that, I enter the remaining sales data and then store it all on disk.

All of these later program segments draw from the input subroutine. ■

Addendum

Since writing this article, Wilde has written a machine language version of the program. It is available from the author.

GOO-GOO, GAA-GAA, REA-DEE...



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A high quality alternative.

Selectric Hard Copy

Michael W. Bickerton, M.D.
2631 Wharton St.
Philadelphia, PA 19146

It didn't take long after buying my TRS-80 for me to realize that I needed hard copy.

As a surgical intern, I didn't have \$700 for a quality printer. But I did have \$75 for a broken-

down, used input-output IBM Selectric.

Although the typewriter was in bad shape, it had the electromagnets and contacts for use with a computer. All I had to do was figure out how to interface the two.

The only information I could find was Emerson Brooks' article, "Taming the I/O Selectric" (*Kilobaud*, June-July 1978). But

Brook's method has several drawbacks.

First, he relies on software to perform all decoding and timing functions. Every carriage return uses 500 ms, even from mid-page.

Also, the software must be loaded every time you want to use the printer. I wanted a driver that would allow the Selectric to operate at its maximum speed of 15 characters per second. I also wanted to be able to simply turn on my TRS-80 and go to work.

My driver solves both problems. It will work with BASIC's LLIST and LPRINT commands without any software patches. It will also decode both upper and lowercase characters, and will work well with such programs as the Electric Pencil. You can even write your own word processor in BASIC, since the TRS-80 will output upper and lowercase strings.

If you don't have a TRS-80, an interface circuit will still let you use this driver.

The Selectric Typewriter

The Selectric mechanism has been used in computer terminals for years.

The models 731 (Photo 1) and 735 are available on the surplus market. The only difference is the 735's wider fifteen-inch mechanism.

The basic Selectric mechanism is sturdy and well de-

signed. A type element the size of a golf ball rotates as you hit each key and types the characters. The printing quality is second to none and is suitable for everything from business letters to hardcopy memory dumps. Also, a number of different typefaces are available.

The Selectric uses a series of electromagnets to activate the proper mechanical clutches. A seven-bit Selectric code directly represents units of ball rotation (R1, R2, R2a and R5) and ball tilt (T1 and T2). The seventh bit is a shift that is actually a 180 degree rotate operation.

For example, the character "s" is represented by 0010001 (the format is shift/T2/T1/R5/R2a/R2/R1, zeros being active in all but shift and R5). To print an "s" the ball tilts two units (T2) and rotates four units (R2 + R2a). The character "S" is represented by 1010001, which is shift, tilt two and rotate four.

The standard Selectric code is called correspondence code, but many Selectrics use BCD (Binary Code Decimal) coding. These codes are not interchangeable, and use different balls. For example, the character "S" is represented by 0100110 in BCD. Also, BCD type balls have only upper case letters, numbers and special symbols.

To tell which kind your Selectric is, buy a standard type ball (correspondence). If your type-



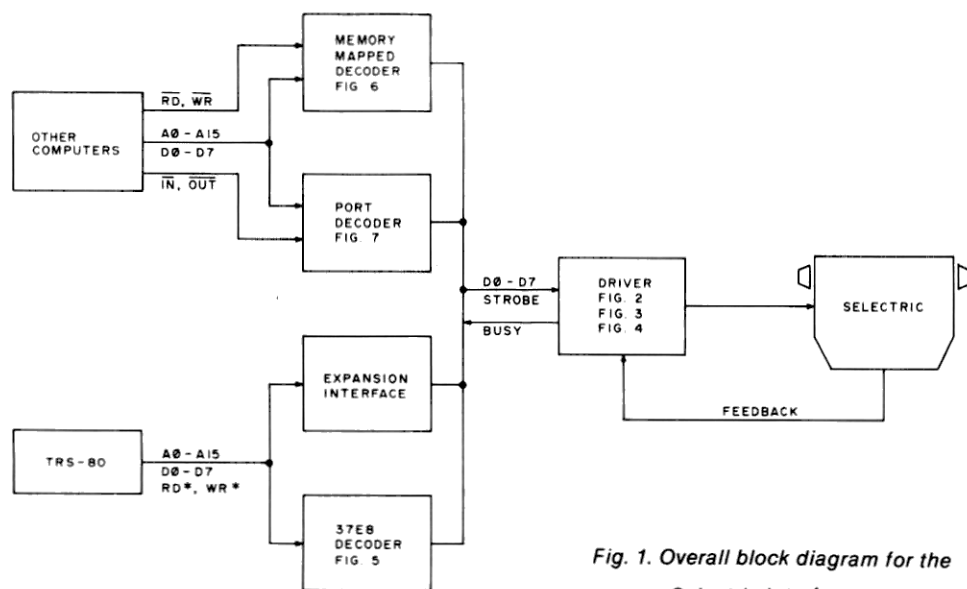


Fig. 1. Overall block diagram for the Selectric interface.

writer prints characters different from those on the keys, you have a BCD machine.

If you use the typewriter as an output device only, a BCD machine works fine. But if you wish to type from the keyboard, you must convert to correspondence. (See Robert M. Weil's "Converting Selectric Keyboards to Correspondence Code," *Kilobaud*, Dec. 1979 and Jan. 1980.)

The Selectric code is shown in Table 1. Note that the characters "<," ">," and "+" are not available on standard type balls. My interface substitutes "l" for "less than," "g" for "greater than" and "E" for "exponentiation."

Photo 2 shows the underside of the Selectric mechanism and Photo 3 shows a close up of the printing (T1, T2, R5, R2a, R2 and R1) electromagnets. Input-output Selectrics also contain a bank of switch contacts, which are directly above the printing electromagnets (Photo 2). These input data from the Selectric to a computer. Since most microcomputers have their own keyboards, you can disconnect the switch bank.

Driver Circuitry

Fig. 2 is a block diagram and Fig. 3 is a schematic of the driver circuit. IC1 and IC2 form the heart of the driver. They are bipolar read-only memories that

convert ASCII into correspondence code. A clever arrangement decodes control commands. If a control function is input D07 goes high. This is fed back to the input through R1 and C2. This serves to re-configure the read-only memories for decoding control commands.

When a strobe pulse is received, the decoded data is latched into eight-bit latch IC3 and IC4. Flip-flop IC11a is also set, providing a busy signal. The strobe pulse propagates through a series of monostable multivibrators. If a control command (carriage return, space, backspace, tab and index) is decoded, pin 2 of IC15 is high and the pulse from IC9a triggers IC10a. IC10a in turn strobes the

control command to the proper relay through IC7 and half of IC6.

If a printing command is received, the situation is more complex. This time pin 4 of IC15 is high and the pulse from IC9a passes through IC12a to trigger IC9b. (IC10b is also triggered but has no effect.) IC9b activates IC5 and half of IC6 and prints the character. It also provides a strobe out to the strobe electromagnet.

If the typewriter is in the incorrect case the pulse triggers only IC10b and shifts up or down. IC12b detects the shift. IC9b then prints the character.

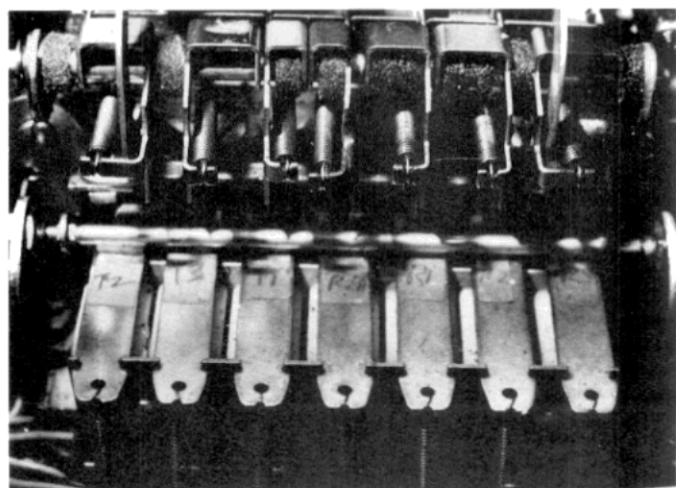
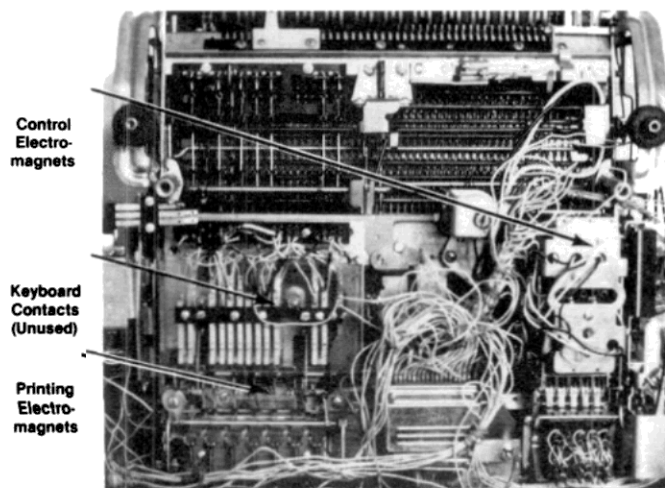
Any print or control operation activates one of five contacts in the typewriter. This is debounced by IC11b and clears IC11a, resetting the busy signal.

The 14 electromagnet drivers (Fig. 4) are identical, and use MJE6043 darlington transistors. The diodes in parallel with the relays protect the transistor from the high voltage induced when the electromagnet is turned off. Since the duty cycle is low, the transistors do not require heat sinking.

The power supply is a conventional full-wave rectifier with a regulated +5 V supply for the TTL integrated circuits. My Selectric had 48 V electromagnets that measure 475 ohms. If your electromagnets measure 125 ohms, then use the alternate 24 V supply.

Photo 2. Bottom view of the Selectric showing keyboard contacts (left), printing electromagnets (left lower) and control electromagnets (right).

Photo 3. Closeup view of printing electromagnets. From left to right they are T2, Strobe, T1, R2a, R1, R2 and R5.



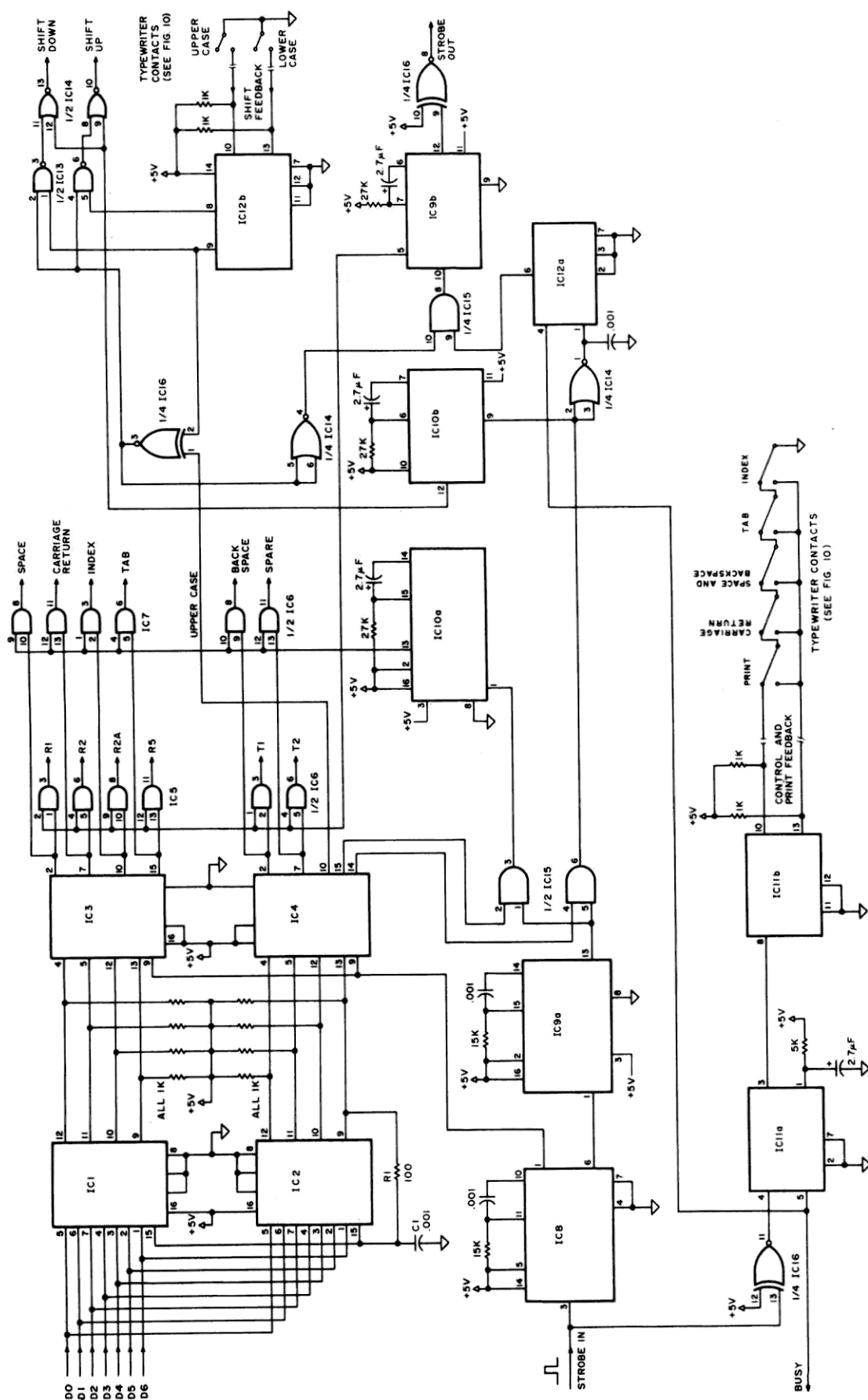


Fig. 3. Schematic diagram of the driver logic. The upper and lowercase contacts and the feedback contacts are located in the typewriter and should be connected as shown.

★★★ A PERCOM BULLETIN ★★★

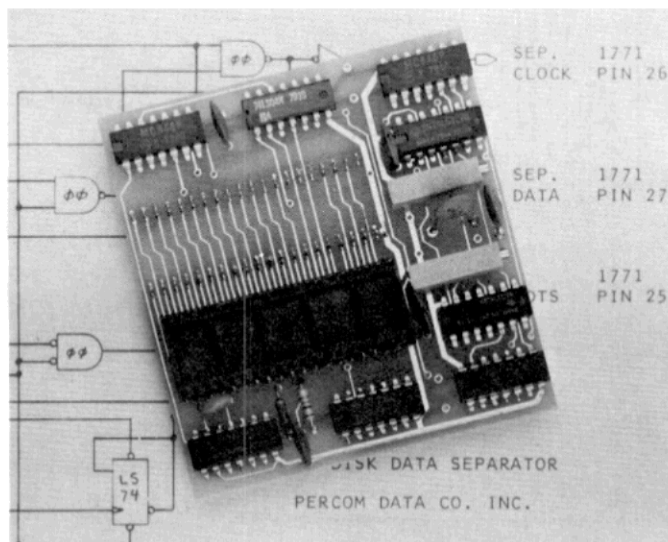
Adapter for TRS-80* computer eliminates disk read errors

Garland, Texas — Harold Mauch, president of Percom Data Company, announced that the company is marketing a simple plug-in adapter for TRS-80* computers that corrects a design deficiency in the disk controller circuit.

The problem, which causes disk read errors, has been traced to Tandy's reliance on a circuit internal to the FD1771 controller IC to perform the function of separating clock and data pulses.

As explained in the *Background*, use of the internal chip circuit for reliable data-clock separation is a design shortcut which the manufacturer of the controller IC warns against.

The Percom solution, a PC card adapter called the SEPARATOR™, eliminates the problem by substituting an explicit data separator circuit



Percom adapter fixes TRS-80* computer disk controller.

— one which has been used reliably in Percom disk controllers since 1977 — for the internal IC separator circuit.

The SEPARATOR™ is installed without modifying the host system. The user merely removes the FD1771 IC from

the host controller, installs the IC in the DIP socket on the SEPARATOR™ card, and plugs the adapter into the vacated socket of the host controller.

Percom cautions that opening the Expansion Interface of the TRS-80* computer, which is required to install the SEPARATOR™, may void the computer's limited 90-day warranty.

The SEPARATOR™, which sells for \$29.95, may be purchased from Percom dealers or ordered direct from the factory. The Percom toll-free order number is 1-800-527-1592.

Payment for mail orders may be made by certified check, cashier's check or money order, or charged to a Master Card or VISA account. Texas residents must add 5% sales tax.

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Both TFD-100™ and TFD-200™ models are available in one-, two- and three-drive configurations.

Prices start at \$399 for a single-drive TFD-100™, \$675 for a single-drive TFD-200™. Drives are supplied with heavy-duty power supplies. Metal enclosure is finished in compatible silver enamel.

See your nearby Percom dealer or order direct by calling toll-free 1-800-527-1592.

Five-Inch Disks Store More Than Eight-Inch Disks!

Garland, Texas — June 25, 1980 — Percom Data Company has begun production of a double-density disk controller adapter for TRS-80* Model I computers.

Harold Mauch, president of Percom, made that announcement here today, saying that data storage capacity using the adapter and double-density disk operating system — which is included — can be increased to as much as 294 Kbytes per minidiskette.

By comparison, the maximum storage for larger eight-inch disk systems used with the TRS-80*

Model I computer is about 290 Kbytes.

Mauch said the PC card adapter, which plugs into the controller chip socket of the computer Expansion Interface, works equally well for either single-density or double-density storage, and users may continue to run programs under TRSDOS*, OS-80™ and other single-density operating systems with the adapter installed.

Price, for the plug-in adapter, the TRSDOS*-like double-density DOS and a utility for converting files and programs from single- to double-density format is expected to be \$219.95.

BACKGROUNDER

CRC ERROR! TRACK LOCKED OUT!

by the Technical Staff
Percom Data Company

This problem started while we were studying an annoying problem with the TRS-80* computer. Disk drives sold by Percom are realigned and tested before shipment. We noticed, however, that some disk drives would pass the Percom inspection but just would not work reliably on the inner tracks with a TRS-80* computer. These drives were within the manufacturer's specifications, and would function perfectly on other disk systems Percom manufactures — "perfectly" here meaning more than 50 million bytes read without error!

The disk read data separation arrangement in the TRS-80* computer Expansion Interface uses an internal data separator of the FD1771 disk formatter/controller IC. Use of the FD1771 internal data separator is not recommended by Western Digital, the IC manufacturer. The following note appears on page 17 of the FD1771 data sheet:

Internal data separation may work for some applications. However, for applications requiring high data recovery reliability, WDC recommends external data separation be used.

We suspected the data separator because the problem was most severe on disk inner tracks where storage density is highest and data separation is most critical.

To prove our point, a technician breadboarded a standard Percom data separator circuit, and configured it to plug directly into the FD1771 IC socket of the TRS-80* computer controller.

When connected to the TRS-80* computer, a troublesome drive functioned perfectly! We ran a BACKUP utility many times and never got a track lock-out. Before we added the external data separator circuit to the computer, this same drive would always lock out tracks, and would have difficulty reading from the inner (higher number) tracks.

The Percom data separator circuit fixes the mini-disk controller of the TRS-80* computer. The type of drives being used is irrelevant; the circuit eliminates disk read errors resulting from the inability of the Tandy controller design to reliably separate clock and data signals when reading high density inner tracks.

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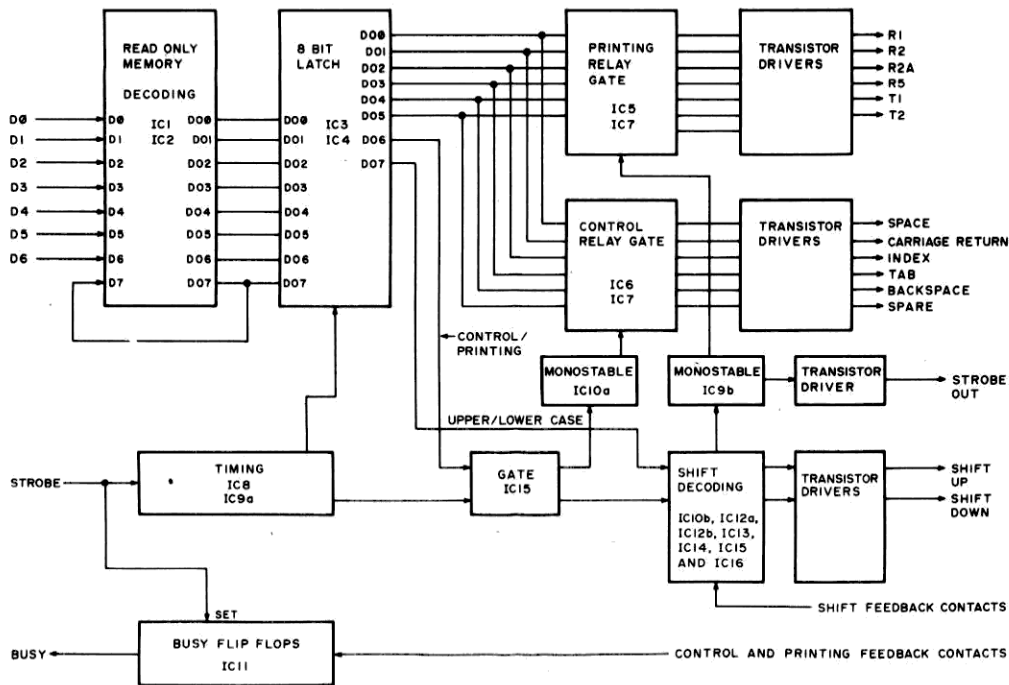


Fig. 2. Block diagram of the driver circuitry. With the exception of the feedback connections, all outputs on the right side of the diagram go to the Selectric electromagnets.

Interface Circuitry

The driver connects directly to the TRS-80 expansion interface. If you don't own the interface, Fig. 5 presents a suitable one.

Radio Shack Level II BASIC reserves memory position 14312 decimal (37E8 hexadecimal) for the line printer. IC20, IC21 and IC22 decode this signal, and pin

6 of IC22 goes low when memory position 14312 is addressed.

Any time the TRS-80 outputs to the line printer, it places the ASCII code on the data bus, outputs 14312 to the address lines and pulses the WR* line low. ("*" denotes a signal that is normally high and goes low when active. Thus, $\overline{WR} = WR^*$.) When this happens pin 1 of IC23 goes high, latching the data into

eight-bit buffer IC18 and IC19 and triggering the monostable IC24 to produce a strobe signal.

Then Level II Basic looks at memory position 14312 by pulsing the RD* line low, and waits until D7 (the busy signal) goes low before outputting another character.

To use another computer, you need to know if your language uses memory mapping or port addressing. Either of the circuits in Figs. 6 or 7 should be suitable.

Fig. 6 is a memory-mapped interface that uses four cascaded 74LS85 four-bit magnitude comparators. When the input address lines A0-A15 are equal to the address programmed on the dip switches SW1 and SW2, the cascade output (pin 6 of IC25) goes high. If the write line WR* goes low, then the data lines D0 to D7 are latched into eight-bit latch IC18 and IC19.

At the same time, IC24, a monostable multivibrator, gives a strobe signal. If the read line RD* goes low, the busy signal is input to the computer. On the TRS-80, D7 inputs the busy status, and D6, D5 and D4 input other status information (which I defeated by tying the lines to the appropriate logic levels). If your

CHAR.	ASCII	CORR.
CR-LF	10-13	128
BS	24	128
INDEX	26	128
SPACE	32	128
!	33	127
"	34	85
#	35	126
\$	36	121
%	37	117
&	38	125
'	39	21
(	40	112
)	41	113
*	42	124
+	43	70
,	44	12
-	45	0
.	46	22
/	47	9
0	48	49
1	49	63
2	50	54
3	51	62
4	52	57
5	53	53
6	54	52
7	55	61
8	56	60
9	57	48
:	58	77
;	59	13
< (1)	60	41
=	61	6
> (g)	62	15
?	63	73
@	64	118
A	65	92
B	66	96
C	67	108
D	68	109
E	69	101
F	70	78
G	71	79
H	72	97
I	73	84
J	74	71
K	75	100
L	76	105
M	77	95
N	78	102
O	79	89
P	80	69

Table 1. ASCII and correspondence codes. All values are decimal. When decoded into binary the correspondence code represents (MSB)Control Character/Shift/T2*/T1*/R5/R2a*/R2*/R1*(LSB).

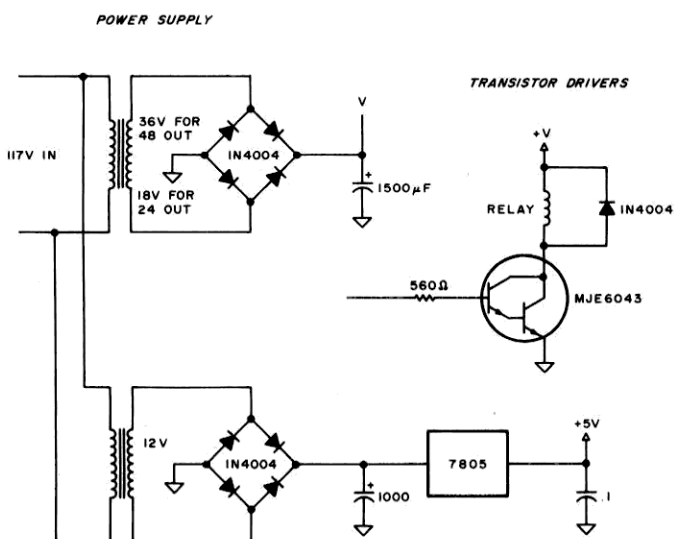


Fig. 4. The transistor drivers are all identical and use MJE6043 transistors. There are 14 transistor drivers; six for T1, T2, R1, R2, R2a and R5, one for the strobe electromagnet, five for the carriage return, space, backspace, tab and index electromagnets and one each for shift up and shift down electromagnets.

language uses another arrangement, connect pins 3, 5, 7 and 9 of IC17 to the appropriate data lines.

Fig. 7 shows a port-based interface circuit. 74LS85 magnitude comparators are again used to compare A0 through A7, with the programmed port address on dip SW1. Instead of RD* and WR* signals, the port interface uses IN* and OUT* lines. Restrictions on status information are the same as for the memory-mapped interface.

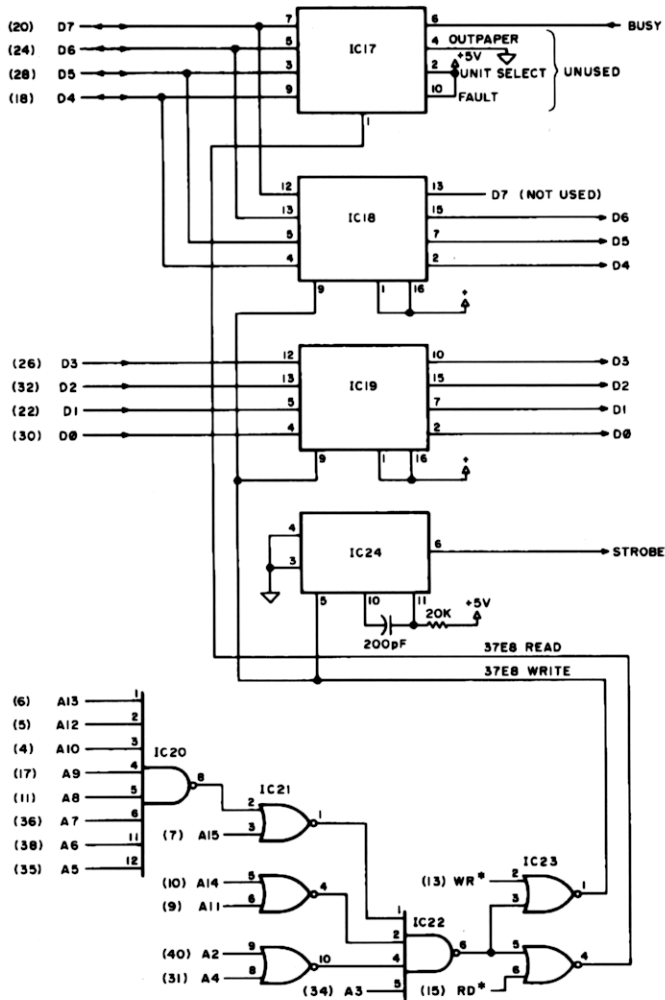


Fig. 5. The interface for the TRS-80. If you have the expansion interface, this circuit is not needed since the signals, D1 to D7, busy and strobe, are available from the expansion interface. Numbers in parentheses correspond to the TRS-80 expansion port edge connector.

Construction

Use any convenient method. The layout isn't critical, so printed circuitry or perfboard is suitable. I used wire-wrap sockets and a slit-n-wrap tool (Photos 4 and 5).

I brought all logic signals out through a 44-pin edge connector for use in a homemade card cage. The transistor drivers, interface circuit and power supply were constructed on separate perfboards.

I had some difficulty locating a 40-pin connector to plug into the TRS-80 expansion port. I finally used an AP edge connector (part number APP924065-36) with a 36-inch ribbon cable permanently attached.

Fig. 8 shows the TRS-80 expansion port pin designations. The TRS-80 uses odd pin num-

bering, which is printed on the circuit board.

Be especially careful when wiring the 40-conductor ribbon cable. I used an ohmmeter to trace each wire and engraved the word "top" on the upper surface of the 40-pin connector to ensure that I would not insert it upside down.

I used 25-pin D plugs and sockets with a 25-conductor ribbon cable to connect the Selectric. Fig. 8 shows my pin designations for the D connectors. My Selectric had a 50-pin plug attached to a heavy metal bracket. I substituted the 25-pin D socket and hooked up the cable.

I wanted to build the complete circuitry into the Selectric typewriter cabinet, but didn't have enough room. If you have the space, you might consider this option.

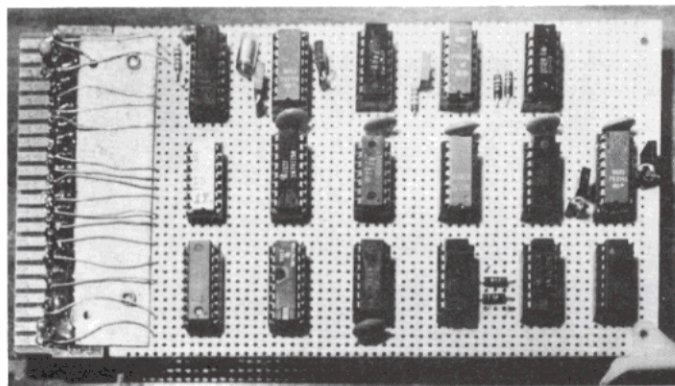


Photo 4 and Photo 5. The driver circuit board. Wire wrap sockets and a slit-n-wrap tool were used. The 44-pin edge connector is for use in a home made card cage.

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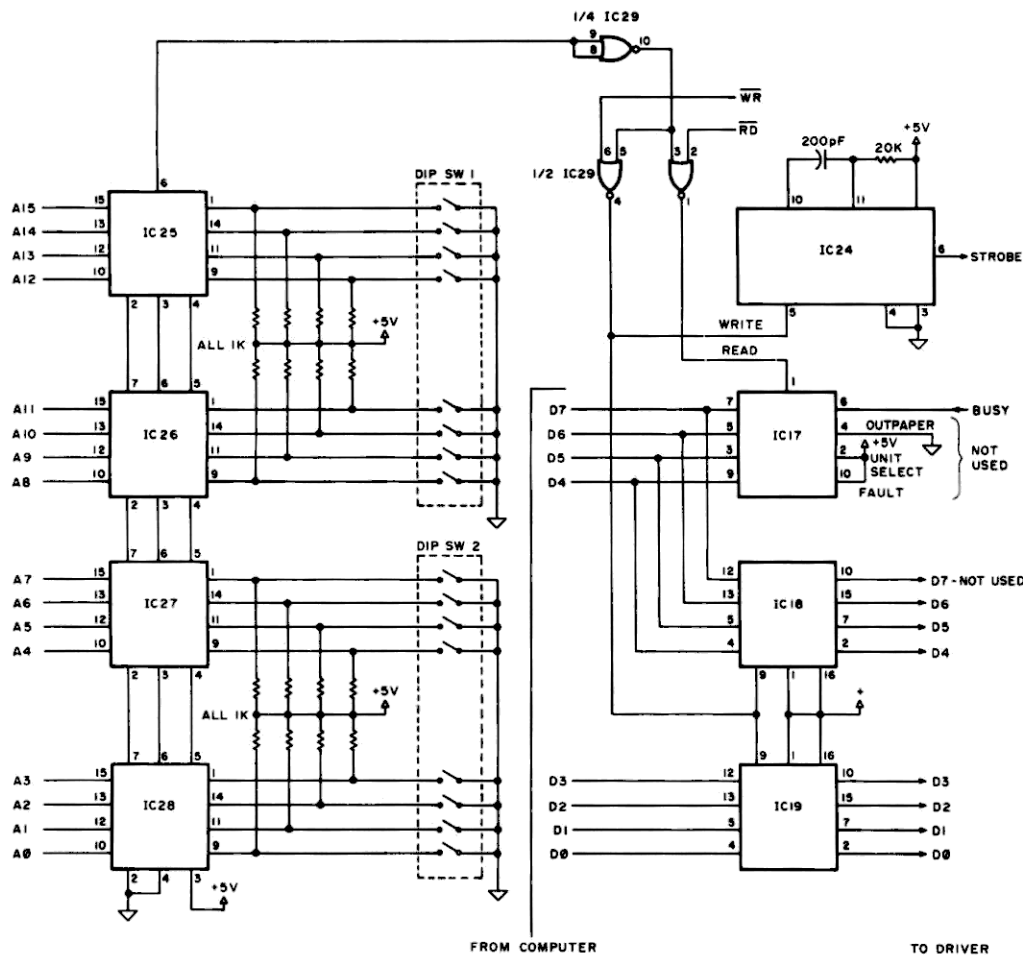


Fig. 6. This circuit will operate with computers that use a memory mapped output to the line printer. The memory location is programmed on SW1 and SW2.

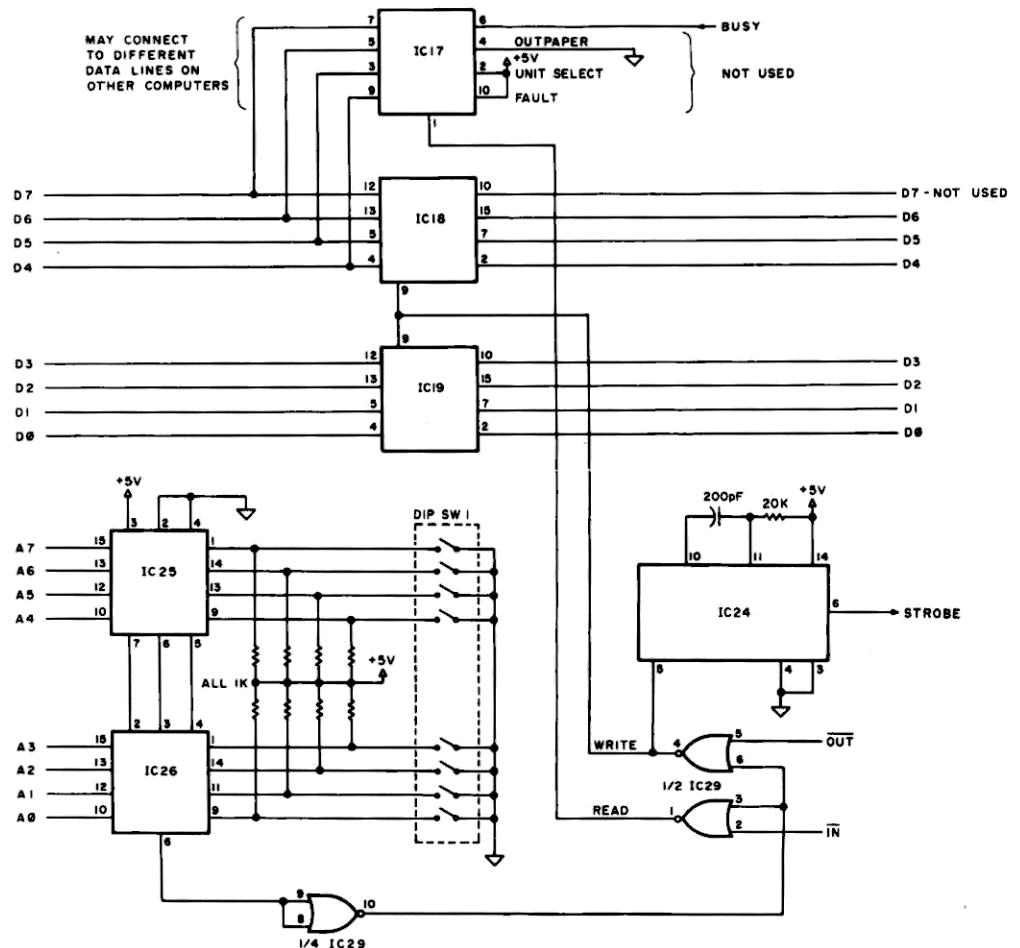


Fig. 7. This circuit will operate with computers that use a port addressing scheme to output to the line printer. The port address is programmed on SW1.



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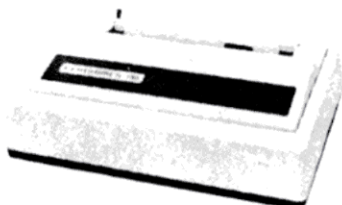
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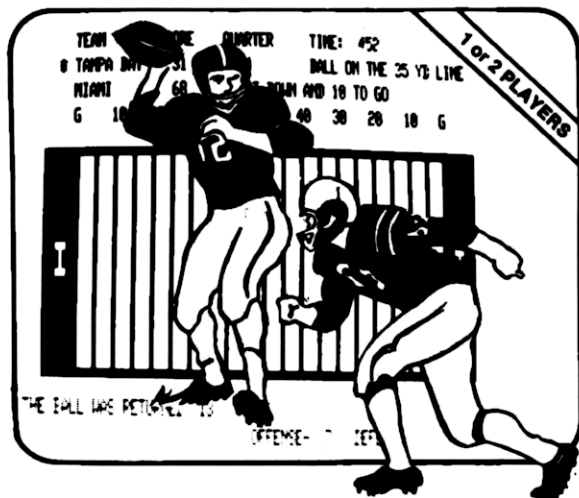
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You compete against a friend or battle against the program in *Pigskin*. If you go against the program, there are five levels of difficulty. And they aren't easy. You can even save a game if you need to go out for beer!

Acorn produces several games for the TRS-80.* These include *Pinball*, a graphic arcade-like game; *Invaders from Space*, a fast action program with sound; *Quad*, a three-dimensional strategy game; and *Gammon Challenger*, the popular backgammon program. Each is available at only \$14.95 on tape and \$20.95 on disk for a 16k, Level II TRS-80.* Ask for these and other quality Acorn programs at your local computer store.

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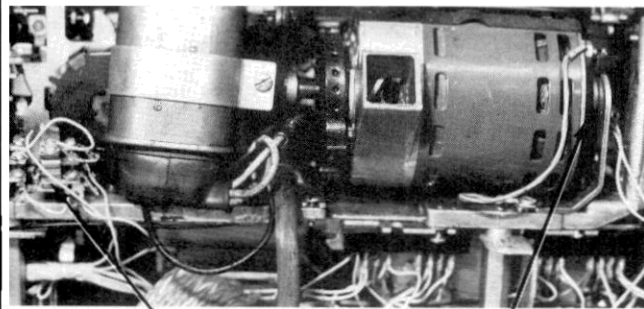


Photo 6. Rear view of the Selectric showing location of the index, space/backspace and tab feedback contacts.

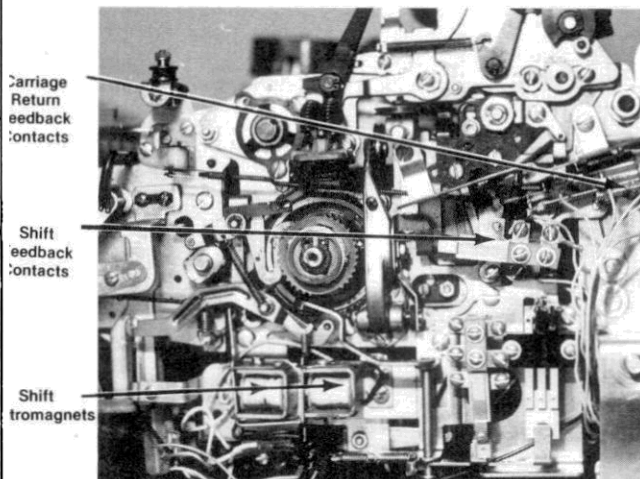


Photo 7. Right side view of the Selectric showing shift feedback contacts, shift electromagnets and carriage return feedback contacts.

My Selectric had a maze of wiring to feedback contacts, electromagnets and keyboard contacts, which I removed or disconnected. I brought the common connection to the electromagnets out to pin 1 on the D socket. My Selectric already has suppression diodes. Check the polarity of these diodes since it might be connected differently. If you have any questions, use suppression diodes on the transistor driver board instead.

Locate the printing and operational electromagnets and wire them to the D socket. Fig. 9 shows the location of these electromagnets. Next, locate all five of the feedback contacts and the two shift feedback contacts, and wire them according to the schematic diagram (Fig. 3). See Photos 6, 7 and 8 and Fig. 10 to locate these contacts.

The final connection is the ground. Attach it directly to the

frame. I used the connector bracket screw.

You can program the read-only memories with the data in Table 5. If you don't have the facilities, I will sell preprogrammed 74S387 ROMs. I'll also consider programming these memories for special features.

Operation

This interface can be used directly with Basic's LLIST and LPRINT commands. Therefore, programs that use the TRS-80 line printer will work without modification.

If you have a program with a large number of PRINT statements that you wish to output to the Selectric, you can retype all PRINT statements, substituting LPRINT.

Here's a neat trick that will accomplish the same thing:

POKE 16414,141:POKE 16415,5

Address	Data	115	137
12	200	116	146
13	200	117	131
14	200	120	105
15	200	121	104
30	200	122	135
32	200	123	121
40	200	124	147
41	177	125	156
42	125	126	136
43	176	127	120
44	171	130	157
45	165	131	101
46	175	132	167
47	025	133	145
50	160	136	200
51	161	137	100
52	174	140	066
53	106	141	034
54	014	142	040
55	000	143	054
56	026	144	055
57	011	145	045
60	061	146	016
61	077	147	017
62	066	150	041
63	076	151	024
64	071	152	007
65	065	153	044
66	064	154	051
67	075	155	037
70	074	156	046
71	060	157	031
72	115	160	005
73	015	161	004
74	051	162	035
75	008	163	021
76	017	164	047
77	111	165	056
100	166	166	036
101	134	167	020
102	140	170	057
103	154	171	001
104	155	172	067
105	145	212	202
106	116	213	202
107	117	214	202
110	141	215	202
111	124	230	220
112	107	232	204
113	144	240	201
114	151	336	210

Table 5. Programmable read only memory (PROM) programming data. A 1702 or 2708 ultraviolet erasable PROM could be used, but I recommend a more permanent bipolar PROM such as the 74S387. All values in this table are octal for easy decoding into binary.

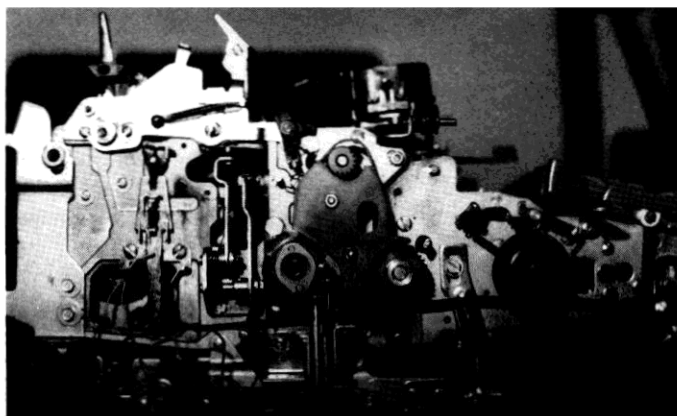


Photo 8. Left side view of the Selectric. The set of contacts in the middle of the photo operate off of the bilobed cam. The inner contacts and cam are used for the print feedback contacts.

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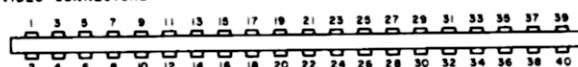
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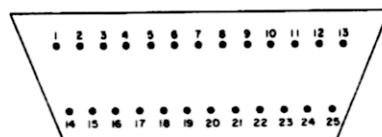


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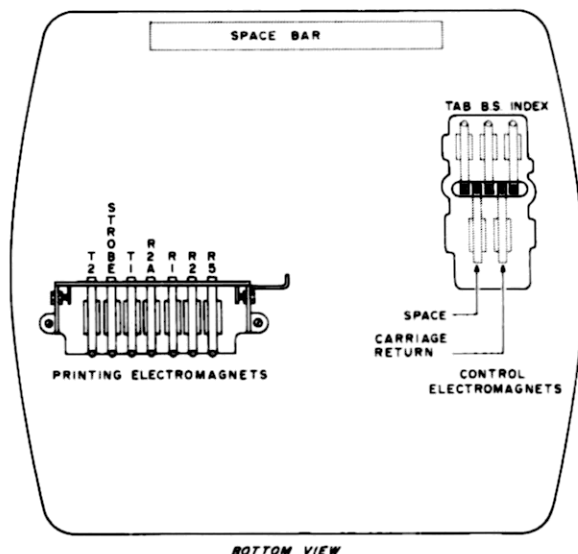


TRS-80 EXPANSION PORT CONNECTOR
REAR VIEW



25 PIN D CONNECTOR

Fig. 8. Pin numbering for the TRS-80 expansion port edge connector and the 25-pin D connector used to connect the driver to the Selectric typewriter.



BOTTOM VIEW

Fig. 9. Location of the printing and control electromagnets viewed from the bottom of the typewriter.

Now, all output ordinarily displayed on the video screen is typed by the Selectric.

If you type these POKE statements while in the command mode in BASIC, be sure to type them together with a colon separating them. Otherwise, after entering the first POKE, you will lose the video display.

If this happens, correctly type the second POKE statement (with the video screen blank) and the Selectric will respond with the familiar READY. Now, anything typed on the TRS-80 keyboard will be echoed by the Selectric.

A better way to use this feature is to place the POKE commands as the first statement in the BASIC program you wish to

alter. This will change all PRINTs to LPRINTs. If you wish to disable this feature (PRINT = PRINT) then use the following command:

POKE 16414,88:POKE 16415,4

This can be used anytime in a program, in the command mode, or in the final statement to reinitialize the video before terminating the program.

In addition, these POKE commands can be used to change LPRINTs to PRINT by using:

POKE 16414,88:POKE 16415,4

To revert back to normal

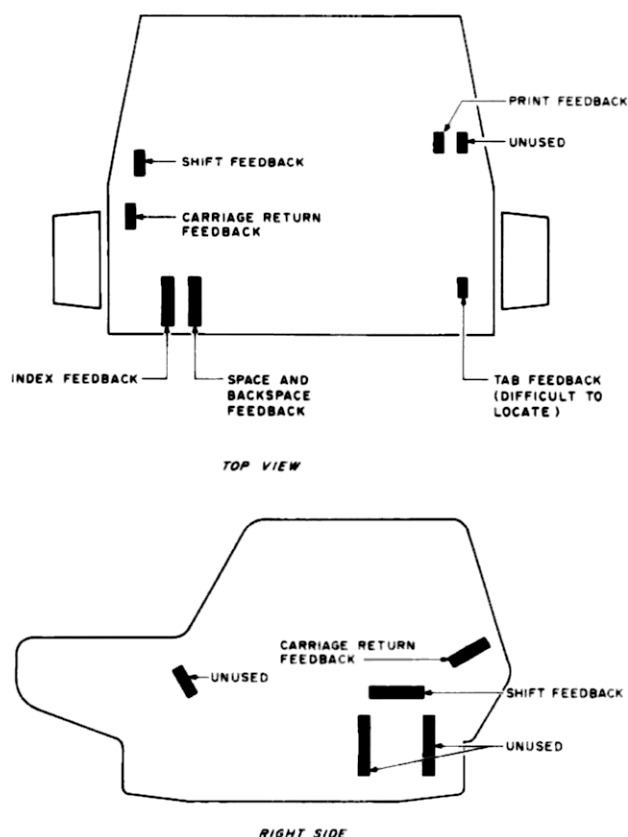


Fig. 10. Location of the feedback contacts.

(LPRINT = LPRINT) use:

POKE 16414,141:POKE 16415,5

Another way to output to the Selectric is by POKEing to memory location 14312. Program Listing 1 causes the Selectric to type all printable characters.

This program outputs ASCII values 33 to 91 and 97 to 122. After POKEing each number to location 14312, the program must wait until D7, the busy signal, is cleared. This is done by the PEEK command in line 50, which causes an endless loop to line 50 until the busy signal goes low.

You can also tell the Selectric

to carriage return and line feed: POKE 14312,10, back space: POKE 14312,24, index: POKE 14312,26, space: POKE 14312,32 and tab: POKE 14312,94. These features may be valuable if you are writing a word processor in BASIC.

To demonstrate upper and lowercase characters, try the following program:

10 INPUT ST\$:LPRINT ST\$

When you run this program you will be asked to input any string. Suppose you respond by typing "Kilobaud Microcomputing," pressing the shift button for "K" and "M," as you would on a normal typewriter. The Selectric will respond by typing "KILOBAUD MICROCOMPUTING."

The TRS-80 will invariably switch cases. To correct this you must write your own input routine.

To display and output upper and lowercase characters properly, you'll need to modify the TRS-80's hardware and soft-

ware. A number of modification kits are on the market. The one I have been using is KVP by Lance Micklus.

Conclusion

I've been using the Selectric with my interface and driver for several months and it has performed flawlessly.

At first, an occasional mis-typed character, or an extra space or dash inserted itself at random, but these mistakes resulted from a misaligned typewriter. I carefully realigned my Selectric and, other than a broken rotate tape, I have had no further problems.

Excellent references for this project include IBM's Service Manual (part no. 241-5257-0), Parts Manual (241-5990-0) and their Price List (241-5158-3).

The Service Manual is particularly well written and well illustrated, and is almost a necessity if your machine needs adjusting. Since IBM will not service machines that do not bear the IBM decal, you may have to make your own adjustments. ■

```
10 FOR I = 33 TO 91:GOSUB 40:NEXT I:I = 10:GOSUB 40
20 FOR I = 97 TO 122:GOSUB 40:NEXT I:I = 10:GOSUB 40
30 END
40 POKE 14312,I
50 IF PEEK (14312) > 100 GOTO 50 ELSE RETURN
```

Program Listing 1.

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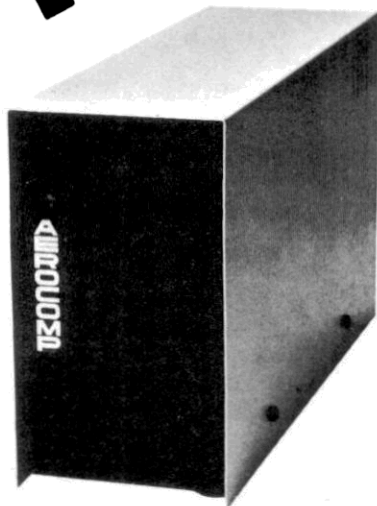
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RADIO SHACK*	NO	40ms.	YES	NO	109K bytes	NO	NO
PERCOM	YES	25ms.	YES	NO	250K bytes (both sides)	YES	NO
MPI	NO	5ms.	YES	YES	125K bytes	YES	NO
SHUGART	NO	40ms.	YES	NO	109K bytes	NO	NO
SIEMENS	NO	25ms.	YES	NO	125K bytes	YES	NO
TANDON	NO	5ms.	NO	NO	125K bytes	NO	NO
PERTEC	YES	25ms.	YES	NO	250K bytes (both sides)	NO	NO
BASF	NO	12ms.	YES	NO	125K bytes	NO	NO

Factual material from current manufacturer's data sheets is believed reliable but cannot be guaranteed, comparing Aerocomp Model 40-1 to similar models.

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FASTLOAD connects to the 40 pin I/O or to the Expansion box. The control program does not use computer memory because it is in a built-in PROM. Other valuable features are keyboard debounce program, automatic key repeat routine and key-beep via cassette speaker. Price is \$188.00 for FASTLOAD and \$95.00 for the modified CTR-41 recorder.

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Build Your Own Port

James S. Hawkes, Ph.D. and
Grady Reese

A computer port is similar to a sailing port, because both serve as points of exchange. At a port a ship unloads its cargo onto the dock where it is stored and later shipped to its main-

land destination.

Similarly, the computer port receives information from an external device and holds it until it is called by the controlling machine. It also stores information sent by the controlling machine, which it can later send to an external device.

A port that only transmits information is an output port; while a port that can only receive information is an input port. Certain bi-direction ports can both receive and transmit.

The Parallel Port

A port permits you to communicate with external devices. Frequently, ports are used in conjunction with other equipment to monitor environmental conditions such as temperature,

wind velocity, voltage, and pressure.

Ports can also be used to control simple on-off functions for hot water heaters, televisions and lights. Through a parallel port eight bits of information (in most microcomputers) are transmitted simultaneously. In some ports data transmission can reach speeds of over 100,000 bytes per second. Because of these high speeds control signals are necessary between the computer and the external device. These are called handshaking signals.

There are two types of parallel I/O. One is called "accumulator I/O" because the byte to be handled by the port must be loaded into the accumulator before it can be transmitted to the port.

The second is called "memory mapped I/O" because a memory read or write instruction is used to access the peripheral. The TRS-80 parallel printer port on the expansion interface is a memory mapped port.

With a small investment of time and money you can build your own port, which can be directly attached to the TRS-80 expansion bus located at the rear of the keyboard, or to the screen printer bus on the expansion interface.

The simple application is made possible by a large scale integrated circuit called a programmable peripheral interface (PPI). The PPI used in this design is the Intel 8255.

The 8255 PPI Chip

The 8255 PPI, originally cre-

INPUT 1	INPUT 2	OUTPUT
LOW	LOW	LOW
LOW	HIGH	HIGH
HIGH	LOW	HIGH
HIGH	HIGH	LOW

Table 1.

Table 2
Port Selection

TRS-80 Address Lines	8255 Port	
A1	A0	Selection
0	0	A
0	1	B
1	0	C
1	1	Control

Table 2. Port Selection.

```

10 REM *** TESTING AND DEMO PROGRAM FOR THE PPI-80 ***
20 REM *** OPS - RECEIVING PORT ***
30 REM *** P - PORT NUMBER ***
40 REM *** N --- NUMBER TRANSMITTED ***
50 REM *** E --- VALUE RECEIVED ***
60 REM *****
70 OUT 131,137:REM *** INITIALIZE PORT ***
80 CLS:N=0:OPS=" ":P=0:E=0:REM *** INITIALIZE VARIABLES ***
90 INPUT "ENTER NUMBER TO BE TRANSMITTED";N
100 IF N>255 OR N<0 THEN 90
110 INPUT "SELECT OUTPUT PORT (A OR B)";OPS
120 IF OPS="A" THEN P=128:REM *** SET PORT NUMBER ***
130 IF OPS="B" THEN P=129:REM *** SET PORT NUMBER ***
140 IF P<128 AND P<129 THEN 110:REM *** TESTS FOR ILLEGAL ENTRY ***
150 OUT P,N:REM *** SEND NUMBER TO SELECTED OUTPUT PORT ***
160 E=INP(130):REM *** READ PORT C ***
170 PRINT @ 120,E
180 FOR I=1 TO 1000:NEXT I:REM *** DELAY LOOP ***
190 GOTO 80

```

Program Listing.

ated to be used with the 8080A microprocessor, can be used with most of the current micro-computer chips including the Z-80.

By sending the appropriate control word in BASIC or machine language to the 8255's control port, you configure the chip's 24 I/O pins in one of three ways: as three independent uni-directional input or output ports; as two uni-directional input or output ports with handshaking signals; or as one uni-directional input or output port plus one bi-directional port with complete handshaking signals on both.

The three major parts of the 8255 (see Fig. 1), are the computer interface, the peripheral interface and the internal control logic.

The computer interface consists of eight data lines, six control lines, and two power supply lines. The data lines D0-D7 are connected to the computer's data lines and are used to transfer

data to and from the computer's data bus.

Next there are the address lines A0 and A1. These two lines use their four possible binary combinations (00,01,10,11) to select one of the four ports within the 8255.

A fundamental requirement for the parallel port is that it must reside at a specific address or addresses. The address chosen is a function of the type of parallel I/O you select. The chip select active low line makes use of the decoded address to select the PPI for an I/O operation.

This brings us to the read (active low) and the write (active low) lines. These two lines are used to tell the chip whether to read or write. They are connected to the computer's memory read (RD) and memory write (WR) lines for memory mapped I/O or to the IN and OUT lines for accumulator I/O. The RESET (active high) will set all ports to their input mode. This initializes the chip and allows it to be

reconfigured.

The next group of pins supports the peripheral interface. Data is transferred to and from external I/O devices through 24 pins which constitute three eight-bit ports. These are called port A (PA0-PA7), port B (PB0-PB7), and port C (PC0-PC7). The user is able to control the function of the I/O lines by sending a control word to the chip's programmable control port.

As stated above, the control word determines for each port one of three operating modes:

- (1) Mode 0—Simple input and output. In this mode the 8255 provides two eight-bit I/O ports (A and B) and two four-bit ports which can operate as one eight-bit port (C). Each port is latched in its output configuration and unlatched in its input configuration. Additionally, each port can be individually defined as input or output.
- (2) Mode 1—Strobed input and output. This mode provides

two uni-directional 8-bit input or output ports (A and B) with port C providing the necessary handshaking signals. Data is latched for both input and output at ports A and B.

- (3) Mode 2—Strobed bi-directional I/O. In this mode there are two usable ports: one bi-directional I/O port (A) and one uni-directional I/O port (B), both with full handshaking provided by port C.

PPI-80 Port Design

The port contains four fundamental parts: the decoder logic, the 8255 PPI, the reset logic, and the power supply.

Because the port is designed to be used with accumulator I/O, only eight address lines A0-A7 must be decoded. Normally, addresses are decoded by using inverters and eight input NANDs (see Rod Hallen's article in *Kilobaud Microcomputing*, January, 1980). While this technique is both straightforward and inexpensive, there is one drawback; the port address cannot be changed without physically rewiring the circuit.

To be able to use the port for a number of different applications, and because of other peripherals which could conflict with some of the four addresses needed to implement the port, it would be advantageous to make it easy to change the port's address.

A simple and inexpensive way to do this uses a DIP switch (S1), a small resistor network (R1-R6), and two exclusive-OR (XOR) ICs, U3 and U4, instead of the traditional inverter. (See Fig. 1.)

The decoding circuit utilizes two 74LS86 integrated circuits, which are quad-two input XOR gates. Remember that the XOR gate produces 1 (high) if the two input signals are of the opposite type, and 0 (low) otherwise. See Table 1, XOR truth table.

If one of the inputs is high, then the other input must be low to obtain a high as an output. Setting the DIP switch (S1) changes the input to one side of XOR gate and causes it to function as an inverting or non-inverting buffer with respect to

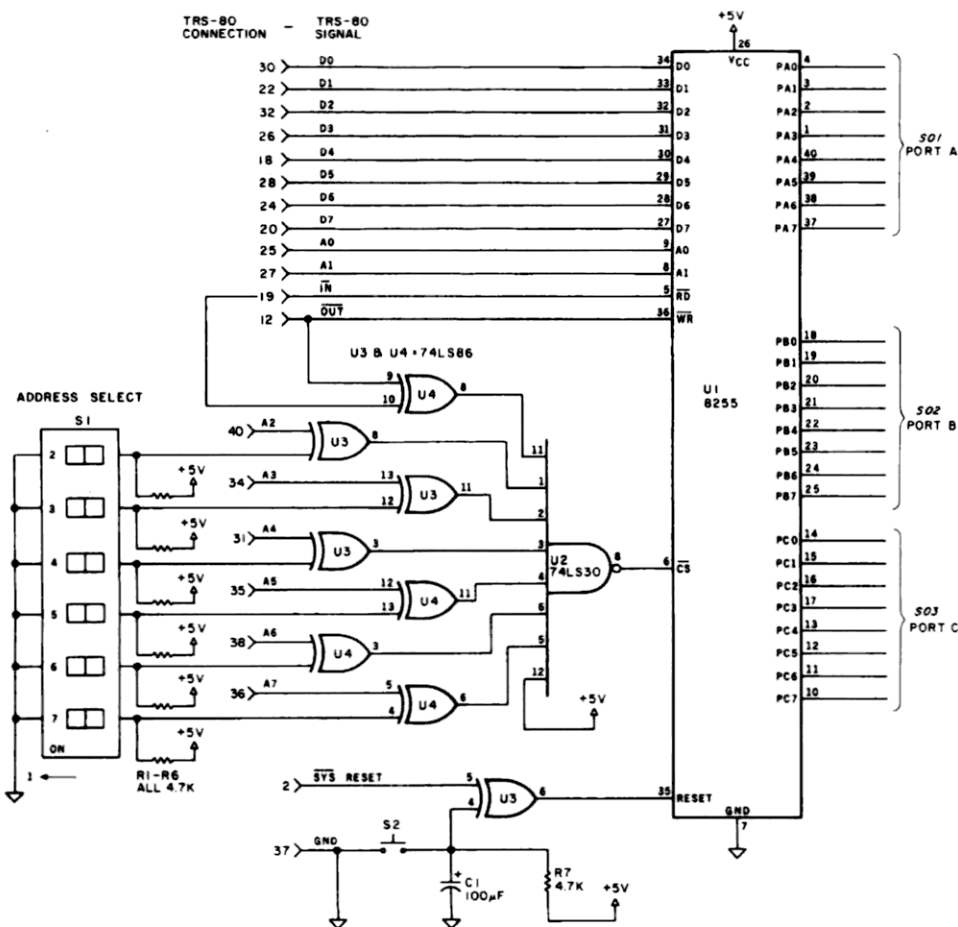
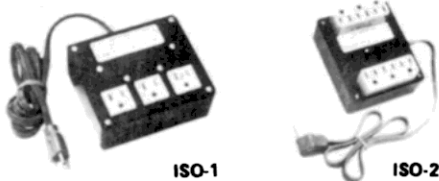


Fig. 1

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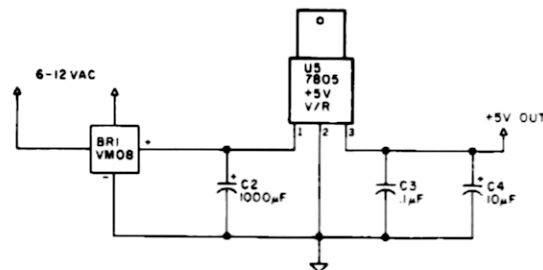


Fig. 1a.

the other input presented at the gate.

To invert an address line, set the appropriate switch on S1 so that the input line to the XOR gate is pulled high (one). Then if one is presented on the other input, an address line, the gate will output at 0, and if a low is presented, it will output a 1. In this state the XOR is functioning as an inverter. Similarly, by setting S1 so that one of the inputs to the gate is low, it acts as a noninverting buffer. By setting S1 switch to invert or not to invert, you can select the address at which you wish to locate your port.

Since the TRS-80 is continuously selecting ROM and RAM addresses, the address lines are always changing. It is likely that the address you select with S1 will be decoded, since the port decodes the lower eight lines only. For this reason we XOR'd the input (IN active low) and Out (OUT active low) signals and used the resulting output as an input to the 8-input NAND.

For the correct address to be decoded and supplied to the 8255 as the CS (active low), it must be present, and either the IN or OUT lines must be low. When the port is properly addressed by the TRS-80, all of the inputs at U2 will be high, and the resulting output will enable the PPI.

After the 8255 is enabled, it must be told what function to perform. That is, if the TRS-80 should read information from the PPI, the IN line must be low. When the CS and IN go low, all that is left to be done is to specify whether I/O port PA, PB, PC or the control port is involved.

The address lines A0 and A1 define which of these ports will be selected. (See Table 2.)

In order to affect an input to the TRS-80 from port C; IN, CS, and A0 must be low while A1 is high. When this condition occurs, the 8255 latches the contents of port C on the data lines, D0-D7, until IN goes high. Amazingly, all this can be done with one BASIC statement.

Sending data to the PPI from the TRS-80 is accomplished in much the same fashion except the OUT (active low) is used instead of the IN.

If you are wondering whether the PPI will be able to receive the data as fast as it can be sent by the CPU, rest your fears. All 8255 input and output can be done in less than 500 nanoseconds. Moreover, all of the 8255's inputs and outputs are TTL compatible.

But, the output drive capability of any port line is limited to one milliamp. This will not even light an LED. Consequently, if you plan to drive more than one TTL load you must provide the proper buffer and/or level shift.

The reset logic utilizes an XOR gate in a very unique way. TRS-80 reset (active low) is tied to one of the inputs of the gate while the other input is tied to an RC network consisting of C1 and R7 (see Fig. 1). This second input of the XOR is also connected to system ground through S2.

During normal operations, the system reset line is held high and the input from the RC network will normally be held high. Thus, the resulting output from the XOR gate will be low. The output of the XOR gate is then fed to pin 35 (reset active high) of the 8255, enabling normal operation of the chip.

This design allows the PPI-80 to be reset in several ways. First, by pressing the TRS-80 reset

button, driving the system reset line low, you cause the XOR output to go high, resetting the 8255. The same condition will occur on power up of the TRS-80.

During power up the RC time constant, formed by C1 and R7, is sufficiently long to insure that the RC input to the XOR gate will remain low longer than the system reset. This causes the 8255 to reset. Thus, the PPI-80 will be reset whenever it is powered up. S2 can also be used to manually reset the PPI-80 by forcing the output of the RC network low.

The remaining part of the PPI-80 is the power supply. Refer to Fig. 1b. The construction is simple because of a 7805 IC. This is a single-package, three-terminal voltage regulator. It contains all the electronics to implement tight voltage regulation plus over voltage and thermal-shutdown protection. The remainder of the circuitry consists of a full-wave bridge rectifier (BR1) and filter capacitors (C2-C4).

Software Considerations

The primary purpose of a port is to communicate with the outside world. The 8255 can do this in one of its three modes.

Mode 0 represents simple I/O. That is, each of the ports in Fig. 1 can perform input or output,

but not both. In this mode the data to be transmitted is latched to the ports.

In other words, if you write a byte to Port A, that bit pattern would stay on the pins PA0-PA7 until another was transmitted. When the TRS-80 reads port C, whatever is latched to pins PC0-PC7 is transferred to the TRS-80.

This type of I/O is used primarily for controlling devices that can be turned on or off. An input port can sense the condition of an on-off switch, and an output port can close or open the switch. This mode is the simplest of the three.

Mode 1 offers one important additional feature—handshaking. In this mode port A and port B can be assigned to input or output data. Port C provides the handshaking signals that synchronize the dialog between two machines. (The handshaking signals present on the 8255 in Modes 1 or 2 are given in Table 3.)

Suppose Port A is an output port. When writing data to an output port, previously transmitted information may not have been read by the external device, causing an overwrite. To prevent overwriting, the 8255 produces a standard handshaking signal, output buffer full (OBF) which is active low. This signal is produced on PC1 for

Resistors		
R1-R7	4700 ohm, 1/4 watt, 5%	RS# 271-1330
Capacitors		
C1	100 uf, 25V electrolytic	RS# 272-1028
C2	1000 uf, 35V electrolytic	RS# 272-1032
C3	.1 uf, 50V ceramic disc	RS# 272-135
C4	10 uf, 16V tantalum cap	RS# 272-1071
Semiconductors		
BR1	1A, 50PIV full wave bridge	RS# 276-1161
U1	8255 PPI	Jameco Electronics
U2	74LS30 8-input NAND gate	RS# 276-1914
U3-U4	74LS86 Exclusive OR gate	Jameco Electronics
U5	7805 voltage regulator	RS# 276-1770
Miscellaneous		
S1	6-position DIP switch	RS# 275-1301
S2	SPST momentary switch	RS# 275-1547
IC sockets	3 14-pin IC sockets	RS# 276-1999
	3 16-pin IC sockets	RS# 276-1998
	1 40-pin IC socket	RS# 276-1996
Transformer	1 modular wall plug type	RS# 60-3053
Cable	1 40 conductor cable	AP# 924065-36-R
Board	1 suitable perf board	RS# 276-152

NOTE: A drilled and etched board is available from Quant Systems, P.O. Box 628, Charleston, SC 29402.

Parts List.

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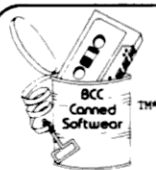
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port B and PC7 for port A in Mode 1.

The user must know when the external device has received the byte sent from the TRS-80; the acknowledge (ACK), which is active low, provides this information. The logic for this signal must be available on the external device.

The remaining signal usually found on an input port is interrupt (INTR), which is active high. This signal goes high when the TRS-80 outputs a byte to the 8255 and remains in this state until the ACK is received from the external device.

When functioning in Mode 1 as an input port, the roles of the handshaking signals are reversed. The 8255 must be signaled when a device is ready to transmit information. This is done by the strobe (STB), which is active low. Upon receiving a strobe, the 8255 stores the byte and sets the input buffer full (IBF) at active high.

The IBF is monitored by the sending device to determine when it can transmit the next byte. As long as this signal remains high, it must wait; but once the TRS-80 reads a byte, this signal is driven low.

By now you must be wondering how the TRS-80 becomes aware of data waiting at the port. Polling techniques can be used for software while the active high interrupt request signal (INTR) is used for hardware. After data is received the INTR is set high (logic 1), but just like the IBF, the INTR is reset by the 8255 after a read.

The most sophisticated form

of parallel I/O is bi-directional, which is provided by the 8255 in Mode 2. Bi-directional I/O is used with an intelligent external device, such as another computer. The 8255 permits port A to function as the data port, while port C provides all the handshaking signals discussed earlier: OBF, IBF, STB, ACK, and INTR. They function in exactly the same manner as in Mode 1 except they are bi-directional.

Using the Port

To read the contents of a port in BASIC you must use INP(port number). This statement is used like a function, such as ABS(X) or SQR(124). It must be used in conjunction with another statement.

In the following example

10 G = INP(127)

the variable G would be assigned the value of the contents of the port 127.

To send a value to the port use the statement OUT port number, value. Any value that is sent must be between 0 and 255. The OUT statement is a complete BASIC statement and requires only a line number to be included in a program. See line 70 in Fig. 2.

Four port addresses must be reserved. The two low-order address lines, A0 and A1, define which port is being addressed. The remaining address lines can be configured to suit your own needs, if they do not conflict with other port definitions.

Bit	Mode 1		Mode 2	
	INPUT Function	OUTPUT Function	INPUT/OUTPUT Function	
0	INTR	INTR	Unused	} PORT B
1	IBF	OBF	Unused	
2	STB	ACK	Unused	} PORT A
3	INTR	INTR	INTR	
4	STB	Unused	STB	} PORT A
5	IBF	Unused	IBF	
6	Unused	ACK	ACK	} PORT A
7	Unused	OBF	OBF	

Depend on Port B definition

Table 3. Port C Functions in Modes 1 and 2.

For example, look at addresses 128, 129, 130, and 131. The decimal address 128 is equivalent to 10000000 binary. Notice that the two least significant bits are 0. Table 2 reveals that if the two low-order bits, corresponding to A0 and A1, are 0 then port A is selected. Ports B, C, and the control port are selected by 129, 130, and 131 respectively.

The 8255 is a programmable port. That is, before using it you must define the mode of operation for each of the ports. By sending the control port the appropriate message, you select the mode of operation for each port.

Table 4 contains control-word bit definitions for the three modes. This is the beauty of the 8255. With a simple software command you can configure the ports as you need to use them.

The software you develop will depend upon the port's application. In Mode 0 the principal operation will be sensing and operating switches. BASIC permits this to be done with relative ease with the INP and OUT instructions discussed earlier.

In Mode 1, however, handshaking signals are required.

Polling Handshake Signals

One technique for handling the handshaking signals is called polling. This requires the controlling program to periodically read the handshaking signals at port C and act on them. The INP command described earlier retrieves the status byte located at port C.

After the TRS-80 sends a byte

to port A, it must not send another until the receiving device retrieves that byte. This can be monitored by scanning the OBF bit in port C. If the OBF bit for port A is low (logic 0), then the TRS-80 should not send a byte because the previous byte has not been read yet. A program can perform some other task and check the status of the bit periodically or can check it continuously.

When the external device receives the byte, it must return the ACK signal to the 8255 which drives the OBF high.

To use port B as an input port, the TRS-80 must know when the external device has sent a byte. This can be determined by checking the IBF signal associated with port B.

Since the IBF is an active high signal, the TRS-80 must scan port C until IBF goes high, which means port B has received a new byte from the external device. Reading the contents of port B will cause the 8255 to drive the IBF low. The sending device must have sufficient logic to send data only when IBF is low.

In Mode 2 operation, port A becomes a bi-directional I/O port. Handshaking signals on port C must be monitored in exactly the same fashion as Mode 1, checking the status of the IBF and OBF signals.

One of the most exciting possibilities of the port is the rapid exchange of information between two computers. The software required is very simple and even BASIC software can create transmission speeds so fast

Bit	Definition
0	Port C Lower PC0-PC3, used in Mode 0 or 1 1 = INPUT 2 = OUTPUT
1	Port B Definition PB0-PB7, used in all modes 0 = OUTPUT, 1 = INPUT
2	Mode Select for Group B: PC0-PC3 and PB0-PB7 0 = MODE 0, 1 = MODE 1
3	Port C Upper PC4-PC7, used in Mode 0 or 1 0 = OUTPUT, 1 = INPUT
4	Port A Definition PA0-PA7, used in Mode 0 and 1 0 = OUTPUT, 1 = INPUT
5-6	Mode select for Group A: PC4-PC7 and PA0-PA7 00 = Mode 0, 01 = Mode 1, 10 = Mode 2, 11 = Mode 2
7	Operation CODE 1 = Mode Set (write control word) 0 = Bit SET/RESET (used to generate clock signals)

Table 4. Control Port Bit Definition.

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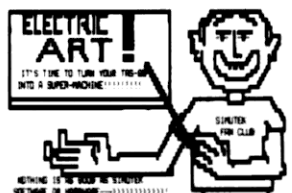
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that the two machines appear to function as one.

Construction

The prototype circuit for this article (Fig. 1) was built on a Radio Shack board (part #276-152). However, since the operation of the circuit is not critical, a good perf board or vectorboard, with either point-to-point wiring or wire wrap should produce good results. It is also possible to purchase an etched and drilled circuit board from Quant Systems, Charleston, SC. IC sockets are recommended regardless of the construction method you use.

Begin assembly by installing the IC sockets for U1-U4 and S1, then solder the resistors in place. Next, mount C2 and wire it into the circuit as indicated in Fig. 1.

Choose connectors for the three 8-bit ports then mount them to the board and wire them to the peripheral interface pins of the 8255. Sixteen-pin IC sockets make convenient connectors for the three I/O ports.

In addition to the eight I/O lines, you may want two power supply lines to provide power to a satellite board. Depending on software definition, you may require as many as three handshaking signals.

Since 13 of the 16 available lines may be utilized, connection to an external device will require a 16-line jumper cable. This method of connection should always yield several spare lines for those oversights that always come up at the last minute.

The circuit requires a +5 volt power supply. While this is available on the TRS-80 bus, it is not recommended for the source because of its limited current capability. Build your own by following the schematic in Fig. 1b, or purchase a suitable plug-in modular supply. Use a +5 volt regulator chip as a safety feature for the ICs.

Switch S2 is used to reset the PPI-80 at the project board. If this capability is not desired, S2 may be omitted. The same reset function is accomplished at power up of either the TRS-80 or the PPI-80 and can also be ac-

complished by pushing the TRS-80 reset button.

Connecting the board to the TRS-80 is straightforward (see Fig. 1). First you need a 40-pin edge connector with cable. These cables were as scarce as dinosaurs, but now are available from several sources, including Hobby World, 19511 Business Center Drive, Northridge, CA 91324.

After making the connections to your board, double-check your work. The TRS-80 edge connector is numbered with even numbers on the bottom, starting at the edge nearest the center of the keyboard. Check the edge connector to the associated IC socket using an ohmmeter.

Testing

Determine if the PPI-80 is working properly by using one of the ports to send data to another. All you need to do is connect the corresponding port lines. (For example, connect PC0-PC7 to PA0-PA7.) Make sure the dip switch is set for port A, to be located at port 128, and enter Program Listing 1.

Note that line 70 writes the control word 137 to the 8255's control port at address 131. This specifies Mode 0 for all ports and defines port C as an input port and ports A and B as output ports.

The remainder of the program permits selection of a number between 0 and 255 to be sent to either port A or B and then to be read by port C. The number received by port C will be displayed and should be equal to the number entered.

Applications

Applications for the PPI-80 are numerous. It can be used to create real time computer games. It can be used for analog to digital conversion to monitor and control a home heating system. Connected to a Sears or Radio Shack remote home controller, it can switch lights and appliances on and off in an empty house. The authors are using their PPI-80 to construct a music synthesizer.

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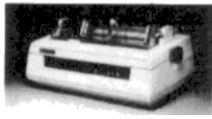
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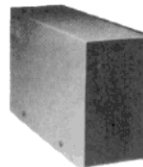
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We designed the program for kindergarten children. But "kid testing" proved that even 2- and 3-year-olds like it. They may not know the letters, but with parental supervision they quickly learn to associate the shapes with names. In fact, they soon learn the sequence and will frequently tell you what object will be displayed before it is even drawn.

Since most children in this age bracket can't read, the com-

puter has trouble communicating with them. An adult must show the child how to respond.

Once into the program, operation is simple. The program uses INKEY\$ so that the child never has to hit the enter key. When he sees a flashing question mark, he types the letter that the object displayed begins with. If he is right, the word RIGHT and a smiling face appear.

If he's not, the screen prints WRONG—TRY AGAIN and draws a sad face. The computer then waits for him to type another letter. He can make any number of guesses.

Before an object is shown, a dummy INKEY\$ picks up any

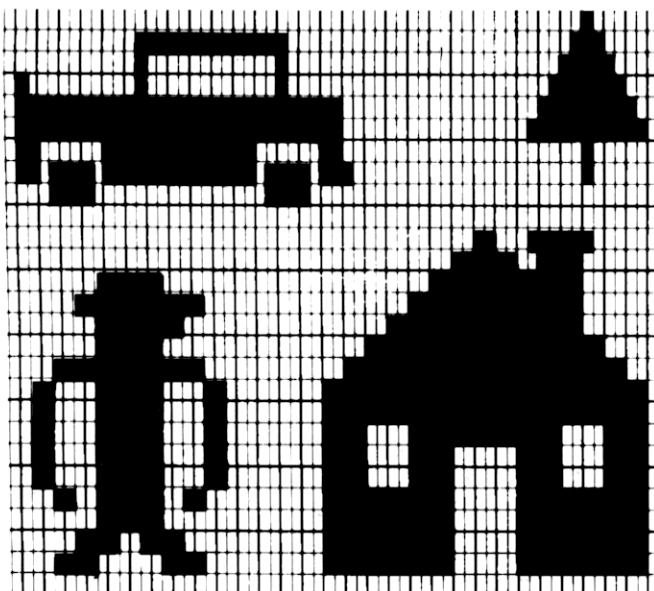


Fig. 1. Sample Shapes

OBJECT	ACCEPTABLE LETTERS
plane	Airplane, Plane, Jet
boat	Boat, Choo-choo
heart	Heart, Valentine
tree	Tree, Christmas tree
cowboy	Cowboy, Bandit, Man, Outlaw
house	House, Building
car	Car, Automobile
castle	Castle, Building
Santa	Santa
dragon	Dragon, Monster
steps	Stairs
clock	Clock, Watch
letter	Letter, Mail, Postcard
toothbrush	Toothbrush, Brush

Table 1. Objects and Their Answers

stray keyboard input. Thus, if the child accidentally leans on a key during animation, the letter won't register as a bad guess when the next object appears.

Most objects have several acceptable answers. Table 1 gives a list of subjects and answers. Consonants are emphasized,

since beginning vowel sounds are more difficult. We didn't try to check every letter in the alphabet.

You'll need 16K Level II or 32K Disk BASIC to run the program. You must put the *exact* number of Xs inside the quotes on strings. Otherwise, the entire

program will bomb. Also be sure to include the second question mark.

One Caution

Because of its string packing routines, this program will not run with Apparat's NEWDOS + unless you put all the strings

at the beginning of the program. Otherwise, all the string locations in later lines would be out in the interface RAM, causing VARPTR to return an error.

Don't be alarmed at the weird screen scrolling when you list after running the program. This is caused by the string packing routines. ■

```

5 CLEAR1000: S=0: GOSUB50000
100 A1$="XXXXX"
101 RESTORE: K=VARPTR(A1$): AD=PEEK(K+2)*256+PEEK(K+1)
102 DATA138, 140, 140, 157, 132
103 FORP=0T04: READX: POKED+P, X: NEXTP
104 A2$="XXXXXXXXXXXX"
105 K=VARPTR(A2$): AD=PEEK(K+2)*256+PEEK(K+1)
106 DATA128, 144, 128, 160, 26, 8, 8, 8, 131, 131, 139, 131
107 FORP=0T011: READX: POKED+P, X: NEXTP
108 A3$="XXXXXXXXXXXX"
109 K=VARPTR(A3$): AD=PEEK(K+2)*256+PEEK(K+1)
110 DATA180, 176, 184, 176, 26, 8, 8, 8, 128, 130
111 FORP=0T09: READX: POKED+P, X: NEXTP
112 A8$="XXXXX"
113 K=VARPTR(A8$): AD=PEEK(K+2)*256+PEEK(K+1)
114 DATA128, 128, 128, 128, 128
120 CLS: FORP=0T04: READX: POKED+P, X: NEXT: FORL=896T0915: PRINTL A3$: GOSUB190: NEXT
130 FORL=915T0264STEP-60: PRINTL -1, A8$: PRINTL A3$: GOSUB190: PRINTL CHR$(30): PRINTL -64, A
26: GOSUB190: NEXTL
150 CLS: PRINT@400, A1$: GOSUB60000: IF (A$="P")OR(A$="A")OR(A$="J") THEN GOSUB62000: GOT0200
160 GOSUB61000: GOSUB60000: GOT0150
190 FORQ=1T018: NEXT: PRINTL -2, " "; PRINTL +64, " "; PRINTL -64, " "; RETURN
200 F1$="XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX"
202 K=VARPTR(F1$): AD=PEEK(K+2)*256+PEEK(K+1)
204 DATA176, 176, 176, 176, 176, 128, 26, 24, 24, 24, 24, 24, 24, 184, 191, 179, 191, 191, 191, 189, 184, 149, 128, 26, 24, 24, 24, 24, 24, 24, 24
, 24, 24, 130, 143, 185, 191, 191, 191, 191, 135, 130, 133, 128
206 FORP=0T048: READX: POKED+P, X: NEXTP
210 F2$="XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX"
212 K=VARPTR(F2$): AD=PEEK(K+2)*256+PEEK(K+1)
214 DATA176, 176, 176, 176, 176, 128, 26, 24, 24, 24, 24, 24, 24, 184, 191, 179, 191, 191, 191, 189, 184, 134, 128, 26, 24, 24, 24, 24, 24, 24, 24
, 24, 24, 130, 143, 185, 191, 191, 191, 191, 135, 130, 137, 128
216 FORP=0T048: READX: POKED+P, X: NEXTP
220 F3$="XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX"
222 K=VARPTR(F3$): AD=PEEK(K+2)*256+PEEK(K+1)
224 DATA176, 176, 176, 176, 176, 128, 26, 24, 24, 24, 24, 24, 24, 184, 191, 179, 191, 191, 191, 189, 176, 140, 128, 26, 24, 24, 24, 24, 24, 24, 24
, 24, 24, 130, 143, 185, 191, 191, 191, 191, 135, 128, 131, 128
226 FORP=0T048: READX: POKED+P, X: NEXTP
230 F4$="XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX"
232 K=VARPTR(F4$): AD=PEEK(K+2)*256+PEEK(K+1)
234 DATA176, 176, 176, 176, 176, 128, 26, 24, 24, 24, 24, 24, 24, 184, 191, 191, 191, 191, 191, 189, 184, 149, 128, 26, 24, 24, 24, 24, 24, 24, 24
, 24, 24, 130, 143, 185, 191, 191, 191, 191, 135, 130, 133, 128
236 FORP=0T048: READX: POKED+P, X: NEXTP
255 B0$="XXXXXXXXXXXX"
260 K=VARPTR(B0$): AD=PEEK(K+2)*256+PEEK(K+1)
265 DATA128, 176, 176, 188, 188, 191, 188, 188, 176, 176, 176
270 FORP=0T018: READX: POKED+P, X: NEXTP: CLS: PO=512
275 PRINT@PO, B0$: FORDE=1T020: NEXTDE: PO=PO+1: IFPO<562 THEN 275
280 CLS: PRINT@450, B0$: GOSUB60000: IF (A$="B")OR(A$="S") THEN GOSUB62000: GOT0300
285 GOSUB61000: GOSUB60000: GOT0200
300 TR$="XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX"
305 K=VARPTR(TR$): AD=PEEK(K+2)*256+PEEK(K+1)
310 DATA128, 188, 188, 140, 140, 140, 160, 171, 151, 26, 24, 24, 24, 24, 24, 24, 24, 24, 128, 160, 191, 191, 191, 191, 191, 191, 191, 144, 26, 24, 24, 24

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Program continues

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, 24, 24, 24, 24, 24, 128, 130, 135, 128, 128, 128, 128, 130, 135  
315 FORP=0T050:READX:POKEAD+P,X:NEXTP  
320 CLS.LO=450.FORP=640T070STEP2:PRINT@P,CHR$(151),:PRINT@P+1,CHR$(131),:NEXT:PRINT@704,STRING$(64,131),  
325 PRINT@LO,TR$:GOSUB375  
330 PRINT@LO,TR$:.PRINT@LO-57,"*",.GOSUB375  
335 PRINT@LO,TR$:.PRINT@LO-58," ",.PRINT@LO-123,"*",.GOSUB375  
340 PRINT@LO,TR$:.PRINT@LO-124," ",.GOSUB375  
345 IFLO<500THEN400ELSEGOTO325  
375 FORDE=0T010.NEXTDE.LO=L0+1.RETURN  
400 CLS.PRINT@400,TR$:GOSUB60000  
410 IFA$="T"ORA$="C"THENGOSUB62000.GOTO1000  
420 GOSUB61000.GOSUB60000.GOTO410  
  
1000 CLS.LO=502.SI#0  
1010 PRINT@LO,F1$:GOSUB1100  
1020 PRINT@LO,F2$:GOSUB1100  
1030 PRINT@LO,F3$:GOSUB1100  
1035 IFLO<452THEN1500  
1040 SI#SI+1.IFSI<2THEN1010ELSEPRINT@LO,F4$:GOSUB1100.SI#0.GOTO1020  
1100 FORQ=1T015.NEXTQ.LO=L0-1.RETURN  
1500 CLS.PRINT@400,F1$:GOSUB60000  
1600 IFA$="F"THENGOSUB62000.GOTO2000  
1700 GOSUB61000.GOSUB60000.GOTO1600  
2000 HE$="XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX"  
2010 K=VARPTR(HE$).AD=PEEK(K+2)*256+PEEK(K+1)  
2020 DATA168,131,131,137,152,131,131,169,26,24,24,24,24,137,144,128,128,128,152,129,26,24,24,24,24,24,130,164,160,134,26,  
24,24,129  
2030 FORP=0T037.READX:POKEAD+P,X:NEXTP  
2040 CLS.PRINT@400,HE$.GOSUB60000  
2050 IF(A$="H")OR(A$="V")THENGOSUB62000.GOTO3040  
2060 GOSUB61000.GOSUB60000.GOTO2050  
3040 TE$="XXXXXXXXXXXXXXXXXX"  
3050 K=VARPTR(TE$).AD=PEEK(K+2)*256+PEEK(K+1)  
3060 DATA128,160,190,180,26,24,24,24,24,128,136,143,175,143,141  
3070 FORP=0T015.READX:POKEAD+P,X:NEXT  
3080 CLS.PRINT@400,TE$.GOSUB60000  
3090 IF(A$="C")OR(A$="T")THENGOSUB62000.GOTO3100  
3095 GOSUB61000.GOSUB60000.GOTO3090  
3100 CO$="XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX"  
3110 K=VARPTR(CO$).AD=PEEK(K+2)*256+PEEK(K+1)  
3120 DATA176,188,188,188,176,176,26,24,24,24,24,24,24,176,176,191,191,191,179,176,26,24,24,24,24,24,24,191,32,32,191,191,19  
1,32,32,191  
3130 DATA26,24,24,24,24,24,24,24,143,176,32,191,191,191,32,176,143,26,24,24,24,24,24,24,24,24,176,188,143,131,131,143,1  
88,176  
3140 FORP=0T076.READX:POKEAD+P,X:NEXTP  
3174 CLS.PRINT@400,CO$:GOSUB60000  
3176 IF(A$="C")OR(A$="M")OR(A$="B")OR(A$="D")THENGOSUB62000.GOTO4000  
3180 GOSUB61000.GOSUB60000.GOTO3176  
4000 HH$="XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX"  
XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX"  
4010 K=VARPTR(HH$).AD=PEEK(K+2)*256+PEEK(K+1)  
4020 DATA128,176,128,160,176,176,144,26,24,24,24,24,24,24,24,128,176,188,191,191,191,188,191,191,26,24,24,24,24,24,24,24,  
24,24,24,24,128,176,188,191,191,191,191,191,191,191,191,191,191,191,191,191,191,191,191,191,191,191,191,191,191,191,191,  
4030 DATA128,191,191,143,143,191,191,191,191,191,191,191,143,143,191,191,26,24,24,24,24,24,24,24,24,24,24,24,24,24,24,24,128  
4035 DATA191,191,176,176,191,191,131,131,131,191,191,176,176,191,191,26,24,24,24,24,24,24,24,24,24,24,24,24,24,24,24,24,128,191,191,  
191,191,191,191,128,128,128,191,191,191,191,191,191  
4050 FORP=0T0151:READX:POKEAD+P,X:NEXT  
4060 CLS.PRINT@336,HH$:GOSUB60000  
4070 IF(A$="B")OR(A$="H")THENGOSUB62000.GOTO4100  
4080 GOSUB61000.GOSUB60000.GOTO4070  
4100 CC$="XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX"  
4110 K=VARPTR(CC$).AD=PEEK(K+2)*256+PEEK(K+1)  
4120 DATA156,140,140,140,140,172,26,24,24,24,24,24,24,24,24,24,24,24,24,170,188,188,188,188,189,188,188,188,188,190,188,188,  
188,148,26  
4130 DATA24,24,24,24,24,24,24,24,24,24,24,24,24,24,24,24,138,133,188,188,138,143,143,143,143,143,143,143,143,133,188,188,138,141  
4140 FORP=0T068:READX:POKEAD+P,X:NEXT
```


PROGRAMMING TOOLS FOR YOUR TRS-80

INSIDE LEVEL II

The Programmers Guide to the TRS-80 ROMS

INSIDE LEVEL II is a comprehensive reference guide to the Level II ROMs which allows the machine language or Basic programmer to easily utilize the sophisticated routines they contain. Concisely explains set-ups, calling sequences, and variable passage for number conversion, arithmetic operations, and mathematical functions, as well as keyboard, tape, and video routines. Part II presents an entirely new composite program structure which loads under the SYSTEM command and executes in both Basic and machine code with the speed and efficiency of a compiler. In addition, the 18 chapters include a large body of other information useful to the programmer including tape formats, RAM usage, relocation of Basic programs, USR call expansion, creating SYSTEM tapes of your own programs, interfacing of Basic variables directly with machine code, a method of greatly increasing the speed at which data elements are stored on tape, and special precautions for disk systems. **INSIDE LEVEL II** is a clearly organized reference manual. It is fully typeset and packed with nothing but useful information. It does not contain questions and answers, ROM dumps, or cartoons. **INSIDE LEVEL II..... \$15.95**

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PROGRAM INDEX FOR DISK BASIC

Assemble an alphabetized index of your entire program library from disk directories. Program names and free space are read automatically (need not be typed in) and may be alphabetized with a fast Shell/Metzner sort by disk or program. The list may also be searched for any disk, program, or extension; disks or programs added or deleted; and the whole list or any part sent to the printer. Finally, the list itself may be stored on disk for future access and update. "The best thing since sliced bread" (January issue of '80 Microcomputing). One drive and 32K required. **INDEX.....\$19.95**

SINGLE STEP THROUGH RAM OR ROM

STEP80 allows you to step through any Basic or machine language program one instruction at a time, and see the address, hexadecimal value, Zilog mnemonic, register contents, and step count for each instruction. The top 14 lines of the video screen are left unaltered so that the "target program" may perform its display functions unobstructed. **STEP80** will follow program flow right into the ROMs, and is an invaluable aid in learning how the ROM routines function. Commands include step (trace), disassemble, run in step mode at variable step rate, display or alter memory or CPU registers, jump to memory location, execute a CALL, set breakpoints in RAM or ROM, and relocate to any page in RAM. The display may also be routed to your line printer through the device control block so custom print drivers are automatically supported. **STEP80.....\$16.95**

4 SPEED OPTIONS FOR YOUR TRS-80!

The SK-2 is the most versatile clock modification available for the TRS-80. Speeds may be switched between normal, an increase of 50%, or a 50% reduction; selectable at any time without interrupting execution or crashing the program. Instructions are also given for a 100% increase to 3.54 MHz, though the TRS-80 is not reliable at this speed. The SK-2 may be configured by the user to change speed with a toggle switch or on software command. It will automatically return to normal speed any time a disk is active, requires no change to the operating system, and has provisions for adding an LED to indicate when the computer is not at normal speed. It mounts inside the keyboard unit with only 4 necessary connections for the switch option (switch not included), and is easily removed if the computer ever needs service. The SK-2 comes fully assembled with socketed IC's and illustrated instructions. **SK-2.....\$24.95**

RAM SPOOLER AND PRINT FORMATTER

This program is a full feature print formatting package featuring user definable line and page length (with line feeds inserted between words or after punctuation), screen dump, and printer pause control. The serial version allows baud rate selection from the keyboard. In addition, printing is done from a 4K expandable buffer area so that the LPRINT or LLIST command returns control to the user while printing is being done. Ideal for Selectric or other slow printers. Allows printing and processing to run concurrently. Please specify PARALLEL or SERIAL (RS-232 interface) version. **SPOOLER.....\$16.95**

DUPLICATE SYSTEM TAPES WITH CLONE

Make duplicate copies of ANY tape written for Level II. They may be SYSTEM tapes (continuous or not) or data lists. The file name, load address, entry point, and every byte (in ASCII format) are displayed on the video screen. **CLONE.....\$16.95**

MACHINE CODE FAST FOURIER TRANSFORM

This complete package includes 3 versions of the machine language FFTASM routine assembled for 16, 32, and 48K machines, a short sample Basic program to access them, a 10K Basic program which includes sophisticated interactive graphing and data manipulation, and a manual of instructions and examples. The machine language subroutines use variables defined by a supporting Basic program to make data entry and retrieval extremely fast and easy for custom implementation. They perform 20 to 40 times faster than their Basic equivalent (256 points in 12.5 seconds), and require less than 1550 bytes of memory. **FFTASM.....\$49.95**

FOR THE MODEL II

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from Midnight Software

High level data communication for the Model II with CP/M. LYNC will send and receive any file with automatic error checking and retries. Either end may initiate file transfers, and multiple files may be sent with wildcard filenames. Remote or local directories may be called from within the program. Allows full protocol, non-protocol, and real-time conversation modes. May be used over phone lines at 300 baud or direct to another computer at up to 9600 baud. Also available for other CP/M computers. **LYNC.....\$95.00**

**MUMFORD
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✓ 144

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Box 435-E Summerland, California 93067 (805) 969-4557

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4150 CLS:PRINT#400,CC$:GOSUB60000
4160 IF(A$="A")OR(A$="C")THENGOSUB62000:GOTO5000
4170 GOSUB61000:GOSUB60000:GOTO4160
5000 CLS:PRINT#704,STRING$(64,131)
5100 PO=455:SW=0
5110 PRINT#635,"*";:PRINT#635," ";:GOTO5130
5120 PRINT#635," ";:PRINT#635,"*";
5130 PRINT#PO,TE$:PRINT#554,CC$:PO=PO+1
5140 IFPO>583THEN5160
5150 SW=SW+1:IFSW>1THENSW=0:GOTO5110ELSE5120
5160 PRINT#500,CHR$(30);:PRINT#564,CHR$(30);:PRINT#628,CHR$(30);:PRINT#692,CHR$(30);
5200 PO=330:SW=0
5210 PRINT#635,"*";:PRINT#635," ";:GOTO5230
5220 PRINT#635," ";:PRINT#635,"*";
5230 PRINT#PO,HH$:PRINT#554,CC$:PO=PO+1
5240 IFPO>370THEN5300
5250 SW=SW+1:IFSW>1THENSW=0:GOTO5210ELSE5220
5300 CLS:FORX=88T0127:FORY=21T047:SET(X,Y):NEXTV,X
5302 FORX=90T091:FORY=20T022:RESET(X,Y):NEXTV,X
5304 FORX=94T095:FORY=21T022:RESET(X,Y):NEXTV,X
5306 FORX=98T0117:FORY=21T028:RESET(X,Y):NEXTV,X
5308 FORX=120T0121:FORY=21T022:RESET(X,Y):NEXTV,X
5310 FORX=124T0125:FORY=21T022:RESET(X,Y):NEXTV,X
5312 FORX=98T099:FORY=34T035:RESET(X,Y):NEXTV,X
5314 FORX=116T0117:FORY=39T040:RESET(X,Y):NEXTV,X
5316 FORX=118T0122:FORY=15T016:SET(X,Y):NEXTV,X
5318 FORY=17T020:SET(122,Y):NEXT
5330 S=1:GOSUB60000:IF(A$="C")OR(A$="B")OR(A$="F")THENGOSUB62000:GOTO5400
5340 GOSUB61000:GOSUB60000:GOTO5330
5400 CLS:SET(50,0):SET(51,0):FORX=46T049:SET(X,1):NEXT:SET(52,1):SET(53,1):SET(44,2):SET(45,2):SET(54,2):SET(55,2):FORX=41T043:SET(X,3):NEXT
5410 SET(56,3):FORX=37T040:SET(X,4):NEXT:SET(56,4):SET(57,4)
5420 FORX=34T036:SET(X,5):NEXT:SET(58,5):SET(59,5):FORX=31T033:SET(X,6):NEXT
5430 SET(60,6):SET(61,6):FORX=28T030:SET(X,7):NEXT:SET(62,7):SET(63,7):FORX=22T024:SET(X,8):NEXT:SET(26,8):SET(27,8)
5440 FORX=68T066:SET(X,8):NEXT:SET(21,9):FORX=25T042:SET(X,9):NEXT:FORX=52T059:SET(X,9):NEXT:FORX=67T071:SET(X,9):NEXT
5450 SET(20,10):SET(27,10):FORX=10T014:SET(38,Y):NEXT:FORX=49T051:SET(X,10):NEXT:SET(55,10):SET(72,10):SET(73,10):SET(19,11):SET(20,11):SET(26,11)
5460 FORX=46T048:SET(X,11):NEXT:SET(74,11):FORX=20T025:SET(X,12):NEXT:FORX=42T045:SET(X,12):NEXT:FORX=63T065:SET(X,12):NEXT
5470 SET(72,12):SET(74,12):SET(22,13):SET(41,13):FORX=55T057:SET(X,13):NEXT:SET(60,13):SET(62,13):FORX=65T067:SET(X,13):NEXT
5480 SET(71,13):SET(73,13):FORX=37T040:SET(X,14):NEXT:SET(47,14):SET(53,14):SET(54,14):FORX=57T059:SET(X,14):NEXT:SET(61,14)
5490 FORX=68T070:SET(X,14):NEXT:SET(72,14):SET(37,15):SET(39,15):SET(46,15):SET(48,15):SET(49,15):SET(51,15):SET(52,15):SET(61,15):SET(72,15):SET(73,15)
5500 SET(38,16):SET(45,16):SET(50,16):SET(66,16):SET(67,16):SET(74,16):SET(75,16):SET(82,12):SET(81,13):SET(81,14):FORX=13T016:SET(8,3,Y):NEXT
5510 SET(79,15):SET(80,15):SET(78,16):FORX=35T037:SET(X,17):NEXT:SET(44,17):SET(64,17):SET(65,17):FORX=49T051:SET(X,17):NEXT:FORX=68T070:SET(X,17):NEXT:SET(76,17):SET(77,17)
5520 SET(82,17):SET(42,18):SET(43,18):SET(54,18):FORX=71T075:SET(X,18):NEXT:SET(80,18):SET(81,18):SET(36,19):SET(37,19):SET(41,19):FORX=45T048:SET(X,19):NEXT:SET(54,19)
5530 FORX=57T060:SET(X,19):NEXT:FORX=63T070:SET(X,19):NEXT:SET(78,19):SET(79,19):SET(36,20):SET(40,20):FORX=44T049:SET(X,20):NEXT:SET(53,20):SET(56,20):SET(61,20):SET(62,20)
5540 FORX=75T077:SET(X,20):NEXT:SET(80,20):FORX=38T040:SET(X,21):NEXT:SET(56,21):SET(60,21):SET(61,21):FORX=72T074:SET(X,21):NEXT:SET(81,21):SET(33,22):SET(41,22)
5550 FORX=53T055:SET(X,22):NEXT:FORX=57T059:SET(X,22):NEXT:FORX=63T070:SET(X,22):NEXT:SET(82,22):SET(34,23):SET(35,23):SET(42,23):FORX=58T052:SET(X,23):NEXT:SET(66,23):SET(68,23)
5560 SET(82,23):SET(34,24):FORX=36T039:SET(X,24):NEXT:SET(42,24):FORX=45T049:SET(X,24):NEXT:FORX=61T065:SET(X,24):NEXT:SET(68,24):FORX=24T026:SET(83,Y):NEXT
5570 SET(35,25):SET(36,25):FORX=40T043:SET(X,25):NEXT:SET(57,25):SET(58,25):SET(60,25):SET(66,25):SET(67,25):FORX=37T041:SET(X,26):NEXT
5580 FORX=46T056:SET(X,26):NEXT:FORX=61T065:SET(X,26):NEXT:FORX=42T045:SET(X,27):NEXT:FORX=27T033:SET(84,Y):NEXT:SET(43,28):SET(44,29):SET(45,30):SET(46,31):SET(47,31)
5590 SET(47,32):SET(48,32):SET(82,33):FORX=34T042:SET(80,Y):NEXT:SET(82,36):SET(81,35):FORX=34T036:SET(83,Y):NEXT:SET(81,38):SET(52,31):SET(51,32):SET(52,32):FORX=49T051:SET(X,33):NEXT:SET(53,33)
5594 SET(51,34):SET(54,34):SET(55,35):SET(56,36):SET(57,37):SET(58,37):FORX=59T061:SET(X,38):NEXT:FORX=62T064:SET(X,39):NEXT:FORX=64T067:SET(X,40):NEXT

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Program continues

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5596 FORX=68T071:SET(X,41):NEXT:FORX=72T075:SET(X,42):NEXT:FORX=76T080:SET(X,43):NEXT:SET(8L,44)
5600 GOSUB60000:IFA$="5"THENGOSUB62000:GOTO5600
5700 GOSUB61000:GOTO5400
5800 MG$=CHR$(188)+CHR$(191)+CHR$(189)+CHR$(188)+STRING$(2,140)+CHR$(26)+STRING$(8,24)
5810 MG$=MG$+CHR$(176)+STRING$(3,191)+CHR$(135)+STRING$(2,131)+CHR$(26)+STRING$(12,24)
5820 MG$=MG$+CHR$(160)+CHR$(184)+CHR$(188)+STRING$(4,191)+CHR$(159)+CHR$(129)+CHR$(26)+STRING$(13,24)
5830 MG$=MG$+CHR$(176)+CHR$(188)+CHR$(190)+STRING$(7,191)+CHR$(135)+CHR$(26)+STRING$(13,24)
5840 MG$=MG$+CHR$(176)+CHR$(190)+STRING$(10,191)+STRING$(3,188)+CHR$(132)+CHR$(26)+STRING$(19,24)
5850 MG$=MG$+CHR$(176)+CHR$(188)+STRING$(10,191)+CHR$(135)+STRING$(5,131)+CHR$(129)+CHR$(26)+STRING$(22,24)
5860 MG$=MG$+CHR$(176)+CHR$(188)+STRING$(11,191)+CHR$(159)+CHR$(129)+CHR$(26)+STRING$(18,24)
5870 MG$=MG$+CHR$(176)+CHR$(188)+STRING$(13,191)+CHR$(135)
5880 M1$=CHR$(160)+CHR$(184)+CHR$(190)+STRING$(6,143)+CHR$(191)+CHR$(159)+STRING$(5,143)+CHR$(191)+CHR$(159)+CHR$(133)+CHR$(26)+STR
NG$(25,24)
5890 M1$=M1$+STRING$(3,176)+CHR$(184)+CHR$(190)+CHR$(143)+CHR$(131)+*CHR$(191)+CHR$(181)+*CHR$(191)+CHR$(181)
5900 CLS:PRINT#416, MG$:PRINT#903, M1$;
5910 RESET(67,19):X=422
5920 A$=INKEY$:IFA$="D"ORR$="M"THENGOSUB62000:GOTO6000
5925 IFA$="O"THENGOSUB61000:GOTO5900
5930 PRINT#448,"?":PRINT#X,"*":FORDE=1T010:NEXT:PRINT#448," ":PRINT#X," ":FORDE=1T010:NEXT
5940 X=X+1
5950 IFX>434THENDX=422
5960 GOTO5920
6000 CLS:X=86:FORQ=XT099:SET(Q,20):SET(Q,21):NEXT
6010 X=X-4:FORQ=XT099:SET(Q,22):SET(Q,23):NEXT
6020 X=X-4:FORQ=XT099:SET(Q,24):SET(Q,25):NEXT
6030 X=X-4:FORQ=XT099:SET(Q,26):SET(Q,27):NEXT
6035 X=X-4:FORQ=XT099:SET(Q,28):SET(Q,29):NEXT
6040 GOSUB60000:IFA$="5"THENGOSUB62000:GOTO6100
6050 GOSUB61000:GOTO6040
6100 CLS:PRINT#165,"1":PRINT#232,"2":PRINT#361,"3":PRINT#488,"4":PRINT#558,"5":PRINT#686,"6";
6110 PRINT#535,"7":PRINT#468,"8":PRINT#339,"9":PRINT#212,"10":PRINT#151,"11":PRINT#94,"12":
6120 FORX=61T075:SET(X,16):NEXT:FORX=6T015:SET(6L,Y):NEXT
6130 SET(60,7):SET(59,8):SET(62,7):SET(63,8):SET(73,14):SET(74,15):SET(74,17):SET(73,18)
6140 FORX=36T086:SET(X,2):SET(X,30):NEXT:FORX=30T025STEP-1:SET(34,Y):SET(35,Y):SET(86,Y):SET(87,Y):NEXT
6150 GOSUB60000:IFA$="C"ORR$="M"THENGOSUB62000:GOTO6200
6160 GOSUB61000:GOTO6150
6200 CLS:FORX=48T0127:SET(X,11):SET(X,33):NEXT:FORX=33T011STEP-1:SET(48,Y):SET(49,Y):SET(126,Y):SET(127,Y):NEXT
6210 FORX=115T0122:SET(X,13):SET(X,18):NEXT:FORX=14T017:SET(115,Y):SET(122,Y):NEXT
6220 PRINT#378,".15":PRINT#282,"CLARK KENT":PRINT#346,"DAILY PLANET":PRINT#418,"METROPOLIS":PRINT#487,"SANTA CLAUS":PRINT#551,"
RD1 BOX1":PRINT#615,"NORTH POLE";
6230 GOSUB60000:IFA$="P"ORR$="L"ORR$="M"THENGOSUB62000:GOTO6300
6240 GOSUB61000:FORX=48T0127:SET(X,33):NEXT:GOTO6230
6300 CLS:Y$=STRING$(16,176)+STRING$(5,186)+CHR$(144):PRINT#468,Y$
6310 GOSUB60000:IFA$="B"ORR$="T"THENGOSUB62000:GOTO6400
6320 GOSUB61000:GOTO6310
6400 END: 'DELETE THIS LINE IF YOU WANT AN ENDLESS LOOP
6410 GOTO100
50000 DEFINT A-Z:CLS:PRINTCHR$(23):PRINT"      MOM & DAD:"
50010 PRINT:PRINT"INSTRUCT CHILD TO HIT THE":PRINT"APPROPRIATE KEY. IF A"
50020 PRINT"TRAIN APPEARS HE SHOULD HIT":PRINT"THE LETTER T WHEN":PRINT"A QUESTION MARK FLASHES."
50030 PRINT:PRINT"HIT ENTER WHEN CHILD IS READY."
50040 A$=INKEY$:IFA$=""THEN50040ELSECLS:RETURN
54000 BREAK
60000 DUMY$=INKEY$
60005 A$=INKEY$:PRINT#448,"?":FORX=1T0100:NEXT
60010 PRINT#448," ":FORX=1T0100:NEXT:IFA$=""THENGOSUB61000:RETURN
61000 SET(16,41):SET(17,40):SET(26,40):SET(27,41):FORX=18T025:SET(X,39):NEXTX
61005 SET(21,37):SET(17,35):SET(18,35):SET(24,35):SET(25,35):PRINT#904,"WRONG!":PRINT#967,"TRY AGAIN";
61008 IFS=1THENS=0:FORX=0T030:FORX=35T042:RESET(X,Y):NEXTY,X:RETURN
61010 FORDE=0T0800:NEXT:PRINT#704,CHR$(30):PRINT#768,CHR$(30):PRINT#832,CHR$(30):PRINT#896,CHR$(30):PRINT#960,CHR$(30);
61020 RETURN
62000 FORX=18T025:SET(X,40):NEXT:SET(17,39):SET(16,38):SET(26,39):SET(27,38)
62005 SET(21,37):SET(17,35):SET(18,35):SET(25,35):SET(26,35)
62010 PRINT#904,"RIGHT!":FORDE=1T0800:NEXT:PRINT#704,CHR$(30):PRINT#768,CHR$(30):PRINT#832,CHR$(30):PRINT#896,CHR$(30);
62020 RETURN

```


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ACCOUNTS PAYABLE

The accounts payable system receives data concerning purchases from suppliers and produces checks in payment of outstanding invoices. In addition, it produces cash management reports. This system aids in tight financial control over all cash disbursements of the business. Several reports are available and supply information needed for the analysis of payments, expenses, purchases and cash requirements. All A/P data feeds General Ledger so that data is entered into the system just once. These programs were developed 5 years ago for the Wang micro-computer and have been tested in many environments since then. The package has been converted to the TRS-80™ and is now a well documented, on-line, interactive micro-computer system with the capabilities of (or exceeding many larger systems.

ACCOUNTS RECEIVABLE

The objective of a computerized A/R system is to prepare accurate and timely monthly statements to credit customers. Management can generate information required to control the amount of credit extended and the collection of money owed in order to maximize profitable credit sales while minimizing losses from bad debts. The programs composing this system were developed 5 years ago, especially for small businesses using the Wang Microcomputer. They have been tested in many environments since then. Each module can be used stand alone or can feed General Ledger for a fully integrated system.

PAYROLL

Payroll involves many complex calculations and the production of reports and documents, many of which are required by government agencies. It is an ideal candidate for the computer. With this Payroll system in-house, you can promptly and accurately pay your employees and generate accurate documents/reports to management, employees, and appropriate government agencies concerning earnings, taxes, and other deductions. The package has been converted to the TRS-80™ and is now a well documented, on-line, interactive micro-computer system with the capabilities of (or exceeding) many larger systems.

CAPABILITIES:

- ★ performs all necessary payroll tasks including:
 - file maintenance, pay data entry and verification
 - computation of pay and deduction amounts
 - printing of reports and checks
- ★ can handle salaried and hourly employees
- ★ employees can receive:
 - hourly or salary wage
 - vacation pay
 - holiday pay
 - piecework pay
 - overtime pay

(Continued on next page)

CAPABILITIES

- ★ menu driven; easy to use; full screen prompting and cursor control
- ★ invoice oriented; everything revolves around the invoice; handles new invoice or credit memo or debit memo
- ★ invoice information recorded; invoice #, description, buyer, check register #, invoice date, age date, amount of invoice, discount (in %), freight, tax (\$), total payable
- ★ transaction print and file maintenance procedures insure accuracy
- ★ flexible check calculation procedure; allows checks to be calculated for a set of vendors - or - for specific vendors
- ★ program prints your checks; contiguous computer checks with your company letterhead can be purchased from SBSG
- ★ reports include (samples on back):
 - open item listing/closed item listing - both detail and summary
 - debit memo listing/credit memo listing
 - aging
 - check register report (to give an audit trail of checks printed)
 - vendor listing and vendor activity (activity of the whole year)
- ★ fully linked to GENERAL LEDGER; each invoice can be distributed to as many as five (5) different GL accounts; system automatically posts to cash and A/P accounts

CAPABILITIES

- ★ menu driven; easy to use; full screen prompting and cursor control
- ★ invoice oriented; invoices can be entered before ready for billing, when ready for billing, after billing or after paid
- ★ allows entry of new invoice, credit memo, debit memo, or change/delete invoice
- ★ allows for progress payment
- ★ transaction information includes:
 - type of A/R transaction
 - customer P.O. #
 - description of P.O.
 - billing date
 - general ledger account number
 - invoice amount
 - shipping/transportation charges
 - tax charges
 - payment
 - progress payment information
 - transaction print and file maintenance procedures insure accuracy
- ★ customer statements printed; computer statements with your company letterhead can be purchased from SBSG
- ★ reports include; (samples on back)
 - listing of invoices not yet billed
 - open items (unpaid invoices)
 - closed items (paid invoices)
 - aging
- ★ fully linked to General Ledger; will post to applicable accounts: debits A/R, credits account you specify

(PAYROLL CAPABILITIES CONTINUED)

- ★ employees can be paid using any combination of pay types (except, hourly cannot receive salary & salary cannot receive hourly)
- ★ special non-taxable or taxable lump sums can be paid regularly or one time (bonus, reimbursements, etc)
- ★ health & welfare deductions can be automatically calculated for each employee
- ★ earnings-to-date are accumulated and added to permanent records; taxes are computed and deducted: US income tax, Social Security tax, state income tax, other deductions (regular or one time)
- ★ paychecks are printed; computer checks with your company letterhead can be purchased from SBSG
- ★ calculations are accumulated for; employee pay history, 941A report, W-2 report, insurance report, absentee report
- ★ fully linked to General Ledger. Each employee's payroll information can be distributed to as many as (12) twelve different GL accounts; system automatically posts to cash account.

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The General Ledger accounting system consolidates financial data from other accounting subsystems (A/R, A/P, Payroll, direct posting) in an accurate and timely manner. Major reports include the Income Statement and Balance Sheet and a "special" report designed by management. The beauty of this General Ledger system is that it is completely user formatted. You "customize" the account numbers, descriptions, and report formats to suit your particular business requirements. These programs were developed 5 years ago for the Wang micro-computer and have been tested in many environments since then. The package has been converted to the TRS-80™ and is now a well documented, on-line, interactive micro-computer system with the capabilities of (or exceeding) many larger systems.

CAPABILITIES

- ★ more than 200 chart of accounts can be handled
- ★ account number structure is user defined and controlled
- ★ more than 1,750 transactions may be entered via:
 - direct posting; done by hand; validated against the account file before acceptance
 - external posting; generated by A/R, A/P, Payroll or any other user source
- ★ data is maintained and reported by:
 - month
 - quarter
 - year
 - previous three quarters
- ★ reports (samples on back) include:
 - trial balances
 - income statement
 - balance sheet
 - special accounts reports and more
- ★ user formats reports with the following designed as you wish:
 - titles
 - headings
 - account numbers
 - descriptions
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15 MULTMON	Computes time needed for money to double, triple, etc.	73 SORT3	Sorts list of names
16 SALVAGE	Determines salvage value of an investment	74 LABEL1	Shipping label maker
17 RRVARIN	Rate of return on investment with variable inflows	75 LABEL2	Name label maker
18 RRCONST	Rate of return on investment with constant inflows	76 BUSBUJ	DOME business bookkeeping system
19 EFFECT	Effective interest rate of a loan	77 TIMECLCK	Computes weeks total hours from timeclock info.
20 FVAL	Future value of an investment (compound interest)	78 ACCTPAY	In memory accounts payable system-storage permitted
21 PVAL	Present value of a future amount	79 INVOICE	Generate invoice on screen and print on printer
22 LOANPAY	Amount of payment on a loan	80 INVENT2	In memory inventory control system
23 REGWITH	Equal withdrawals from investment to leave 0 over	81 TELDIR	Computerized telephone directory
24 SIMPDISK	Simple discount analysis	82 TIMUSAN	Time use analysis
25 DATEVAL	Equivalent & nonequivalent dated values for oblig.	83 ASSIGN	Use of assignment algorithm for optimal job assign.
26 ANNUDEF	Present value of deferred annuities	84 ACCTREC	In memory accounts receivable system-storage ok
27 MARKUP	% Markup analysis for items	85 TERMSPAY	Compares 3 methods of repayment of loans
28 SINKFUND	Sinking fund amortization program	86 PAYNET	Computes gross pay required for given net
29 BONDDVAL	Value of a bond	87 SELLPR	Computes selling price for given after tax amount
30 DEPLETE	Depletion analysis	88 ARBCOMP	Arbitrage computations
31 BLACKSH	Black Scholes options analysis	89 DEPRSF	Sinking fund depreciation
32 STOCVAL1	Expected return on stock via discounts dividends	90 UPSZONE	Finds UPS zones from zip code
33 WARVAL	Value of a warrant	91 ENVELOPE	Types envelope including return address
34 BONDDVAL2	Value of a bond	92 AUTOEXP	Automobile expense analysis
35 EPSEST	Estimate of future earnings per share for company	93 INSFILE	Insurance policy file
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37 SHARPE1	Portfolio selection model-i.e. what stocks to hold	95 DILANAL	Dilution analysis
38 OPTWRITE	Option writing computations	96 LOANAFD	Loan amount a borrower can afford
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46 TRANS	Transportation method for linear programming		
47 EOQ	Economic order quantity inventory model		
48 QUEUE1	Single server queueing (waiting line) model		
49 CVP	Cost-volume-profit analysis		
50 CONDPFRO	Conditional profit tables		
51 OPTLOSS	Opportunity loss tables		
52 FQOQOQ	Fixed quantity economic order quantity model		
NAME	DESCRIPTION		
53 FQOOWSH	As above but with shortages permitted		
54 FQOQPB	As above but with quantity price breaks		
55 QUEUECB	Cost-benefit waiting line analysis		
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My Way

Robert V. Meushaw
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I'm sure that many of you have been faced with situations in which the program you were writing just wouldn't perform to your expectations because of limitations which seemed beyond your control. In some cases, processor speed or inefficient data storage techniques may limit your capabilities; but in almost every hopeless situation I work on, I find that, with perseverance, there is always a better way.

One of the most important lessons I have learned while programming is that you should use your computer to help you analyze and resolve your programming problems.

I would like to describe several programming applications I have faced with my Level I TRS-80 and the approaches that I used to investigate such limitations.

Problem One

Computing vector magnitudes when given the X and Y-coordinates (Fig. 1) requires a

square root function that is unfortunately not built-in to the Level I. Fortunately, the appendix of the Level I manual includes a square root function (Listing 1), but it performs much slower than I would have liked. Watching the results being printed, I can almost feel the burden of the routine. After this I begin to investigate how to improve the speed of my program.

Looking at Listing 1, you can see that the routine makes successive approximations to the square root of X which eventually converge (within the limits of the computer's accuracy) to the square root of X. The first approximation, Y, is taken as $X/2$.

The value of W keeps track of the error in the approximation and whenever the error is zero or is the same as the previous iteration, the subroutine returns with Y as the square root of X.

This seems fairly straightforward, but, as you can see, there is really quite a lot going on in one iteration, which is reason enough for its lack of speed.

Wondering how many iterations of such a routine are necessary to compute a square root, I decided to make some tests.

The test program is shown in Listing 2. It generates random

numbers to be input to the square root subroutine. Each time a new number is generated, a counter is set to zero. Then the square root subroutine is called, and modified to increment the counter with each iteration.

When the subroutine returns, C contains the number of iterations necessary to compute the square root of X. The value of C is used to increment the array element A(C).

Using this technique, the array element A(i) keeps count of the number of values of X which require iterations in the square root subroutine to return an answer.

The first three lines in the program initialize the array elements to zero. Line 50 deter-

mines the value of X.

This line is not fully specified in the listing because I ran the program a number of times with different expressions for X. In each case the program examines 15,000-20,000 values of X. This often requires several hours of run time. (On several occasions I let the test run overnight.)

Usually, when a reasonable number of samples has been examined, I interrupt the program and execute the routine beginning on line 2000 which displays the percentage of samples requiring iteration counts of one to one hundred.

Some Interesting Results

The program is first run with $X = \text{RND}(0)$. This sets X equal to

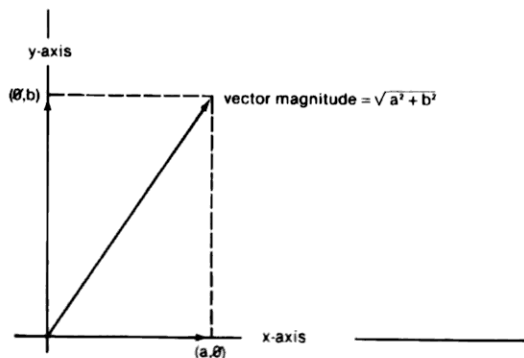


Fig. 1

a random number between 0 and 1. The resulting iterations are shown in Table 1. Beside each iteration value is its percentage.

We can see that 34.6 percent of the numbers require six iterations, 48 percent require seven iterations, and so on. The high-

est number of iterations recorded is fourteen, and no number requires five or less.

Table 2 shows the results using $X = 1/\text{RND}(30000)$. The range of iterations is between seven and fourteen, with the largest percentage of the numbers requiring more than twelve.

Table 3 shows the results of $X = \text{RND}(30000)$. These results appear similar to those of Table 2 except that the range of iterations is offset slightly.

The last set of results, shown in Table 4, is the result of using $X = \text{RND}(0) * 1\text{E}10$. I chose this to give some very large values for X. Again, the results appear similar to those in Table 2 with a larger offset than in Table 3.

The Search Begins

Now that I have a reasonable understanding of how the square root subroutine is working, and why it is consuming so much time, the problem remains to find a technique to reduce the time.

My first thought is to investigate other methods of computing the square root. One technique, which often yields good results, is a power series approximation. These approximations are used in calculating many functions including sine, cosine, natural log and other functions. The advantage of such a technique is the elimination of the numerous iterations the computation requires—thus saving time.

Since it has been many years since I encountered such approximation techniques, I find myself digging out college books, which I had hoped never to see again. Though it was not as clear to me now how a Taylor Series or Maclaurin Series approximation works, I eventually convinced myself that there is no simple expansion which I can use.

As is clear from Tables 1-4, larger numbers require more iterations to compute the square root. Part of the reason for this is that the first approximation to the square root is taken as $X/2$, which becomes a worse approximation as X increases or decreases. Again, I consider a power series approximation such as:

IF ($X < 10$) THEN $Y = X/2$
IF ($X > 10$) AND ($X < 100$) THEN $Y = X/4$
IF ($X > 100$) AND ($X < 1000$) THEN $Y = X/20$

I experiment with several variations of this form, but none yield a significant reduction in the number of iterations.

A Glimmer of Light

Finally, I realize that I need to look for a solution to my specific application and not a general one.

Looking back at Fig. 1, I notice that I am not trying to find the square root of just any number, I am trying to find the length of the hypotenuse of a right triangle—knowing the length of each side!

Eureka!! I have found the first approximation—the sum of the lengths of the sides of the triangle (i.e., $A + B$).

My next task is to determine how good my approximation method really is. Listing 3 shows the program which I used

```
30010 REM *SQUARE ROOT* INPUT X, OUTPUT Y
30020 REM ALSO USES W AND Z INTERNALLY
30030 IF X=0 THEN Y=0: RET.
30040 IF X>0 THEN 30060
30050 PRINT "ROOT OF NEGATIVE NUMBER?": STOP
30060 Y=X*.5: Z=0
30070 W=(X/Y-Y)*.5
30080 IF (W=0) + (W=Z) THEN RETURN
30090 Y=Y+W: Z=W: GOTO 30070
```

Listing 1. TRS-80 Level I manual square root subroutine (shorthand notation has been expanded).

```
10 FOR I=1 TO 100
20 A(I)=0
30 NEXT I
40 J=1
50 X=(...one of several statements...)
60 C=0
70 GOSUB 1000
80 A(C)=A(C)+1
90 PRINT J;" VALUES HAVE BEEN USED"
100 J=J+1
110 GOTO 50
120 END

1000 Y=X*.5: Z=0
1010 W=(X/Y-Y)*.5
1020 C=C+1
1030 IF (W=0) + (W=Z) THEN RET.
1040 Y=Y+W: Z=W: GOTO 1010

2000 T=0
2010 FOR I=1 TO 100
2020 T=T+A(I)
2030 NEXT I
2040 FOR K=1 TO 100
2050 PRINT K, 100*A(K)/T
2060 NEXT K

INITIALIZE ARRAY WHICH COUNTS NUMBER OF SAMPLES
FOR EACH ITERATION COUNT
J COUNTS NUMBER OF SAMPLES
PICK RANDOM VALUE FOR X
INITIALIZE NUMBER OF ITERATIONS
COMPUTE SQUARE ROOT
UPDATE PROPER COUNTER
PRINT NUMBER OF SAMPLES USED
UPDATE SAMPLE COUNT
KEEP GOING

COMPUTE APPROX. TO SQ. ROOT
COMPUTE ERROR
UPDATE ITERATION COUNT
IF DONE, RETURN
ELSE COMPUTE NEW APPROX.

SET TOTAL TO ZERO
COMPUTE THE SUM
OF THE NUMBER OF SAMPLES
FOR ALL ITERATION COUNTS
SET LOOP TO PRINT ALL
ITERATION COUNTS IN
PERCENTAGE OF TOTAL
```

Listing 2. Program used to investigate the operation of the square root subroutine. The program was run with the value of X in line 50 given as $X = \text{RND}(0)$, $X = 1/\text{RND}(30000)$, $X = \text{RND}(30000)$, and $X = \text{RND}(0) * 1\text{E}10$. The program starting at line 2000, run after a sufficient number of samples were taken, prints the percentage of numbers for each iteration count.

```
10 FOR I=1 TO 100
20 A(I)=0
30 NEXT I
40 J=1
50 A=(...various expressions...)
51 B=(...various expressions...)
60 X=A*B
70 C=0
80 GOSUB 1000
90 A(C)=A(C)+1
100 PRINT J;" VALUES HAVE BEEN USED"
110 J=J+1
120 GOTO 50
130 END

1000 Y=A+B: Z=0
1010 W=(X/Y-Y)*.5
1020 C=C+1
1030 IF (W=0) + (W=Z) THEN RET.
1040 Y=Y+W: Z=W: GOTO 1010

INITIALIZE ARRAY WHICH COUNTS
NUMBER OF SAMPLES FOR EACH
ITERATION COUNT
J COUNTS NUMBER OF ITERATIONS
PICK RANDOM VALUES
FOR A AND B
COMPUTE SQUARE OF VECTOR MAG.
INIT. NUMBER OF ITERATIONS
COMPUTE SQUARE ROOT
UPDATE PROPER COUNTER
PRINT MESSAGE
UPDATE SAMPLE COUNT
KEEP GOING

COMPUTE FIRST APPROX.
COMPUTE ERROR
UPDATE ITERATION COUNT
IF DONE, RETURN
ELSE MAKE NEW APPROX.
```

Listing 3. Program used to compute the square root of X using the first approximation $Y = A + B$.

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NUMBER OF ITERATIONS % OF NUMBERS TESTED

<= 5	0
6	34.6
7	48
8	13
9	3.3
10	.87
11	.16
12	.056
13	.01
14	.004
>= 15	0

Table 1. Distribution of square root iteration counts for $X = \text{RND}(0)$.

NUMBER OF ITERATIONS % OF NUMBERS TESTED

<= 6	0
7	.03
8	.04
9	.33
10	1.2
11	5.4
12	19.3
13	47.8
14	25.9
>= 15	0

Table 2. Distribution of square root iteration counts for $X = 1/\text{RND}(30000)$.

NUMBER OF ITERATIONS % OF NUMBERS TESTED

<= 3	0
4	.004
5	.02
6	.076
7	.3
8	1.15
9	4.85
10	19
11	47.4
12	27.2
>= 13	0

Table 3. Distribution of square root iteration counts for $X = \text{RND}(30000)$.

NUMBER OF ITERATIONS % OF NUMBERS TESTED

<= 14	0
15	.05
16	.17
17	.95
18	3.51
19	14.12
20	47.1
21	34.1
>= 22	0

Table 4. Distribution of square root iteration counts for $X = \text{RND}(0) * 1E10$.

NUMBER OF ITERATIONS % OF NUMBERS TESTED

<= 2	0
3	1.1
4	13
5	52.3
6	33.6
>= 7	0

Table 5. Distribution of square root iteration counts using $A = \text{RND}(0)$ and $B = \text{RND}(0)$ and modified first approximation.

to generate the lengths of each side of the right triangle and the number whose square root I needed. As in the previous set of test cases, program statements 50 and 51 are incomplete because I used four sets of values to test the same conditions as before.

The program is first run using $A = \text{RND}(0)$ and $B = \text{RND}(0)$. The value of X is computed as $(A^2 + B^2)$. Table 5 shows the result of using the new first approximation for the square root.

Compared with Table 1, the number of iterations is significantly reduced. In this case, most numbers require five or fewer iterations whereas Table 1 shows that most numbers require seven or more iterations.

Table 6 shows the results of the new approximation when $A = \text{RND}(30000)$ and $B = \text{RND}(30000)$. Notice that the results are remarkably similar to those obtained in Table 5.

Table 7 shows the results obtained using $A = 1/\text{RND}(30000)$ and $B = 1/\text{RND}(30000)$, and Table 8 shows the results obtained using $A = \text{RND}(0) * 1\text{E}10$ and $B = \text{RND}(0) * 1\text{E}10$.

I am astounded that the results obtained using the new approximation are almost identical in the four cases that I tested. I noticed two other important facts. Most of the num-

bers required five or six iterations, and also no numbers more than six iterations.

This second fact is most important since it tells me that I can construct a new square root routine eliminating the logical tests necessary to determine completion of the routine.

Referring to Listing 1, I can remove line 30080 by changing the basic structure of the routine to

"The savings in storage amounts to about 25 bytes, which is enough to give me the breathing room I need."

a FOR-NEXT loop using six iterations. Listing 4 gives the resulting square root routine, a faster version.

It seems wasteful to perform six iterations when some numbers require less, but looking at the statistics of Tables 5-8 you can see that 85 percent of the numbers require five or six iterations. Therefore, the instances of inefficiency are small.

NUMBER OF ITERATIONS	% OF NUMBERS TESTED
<= 2	0
3	1.1
4	12.7
5	52.1
6	34.1
>= 7	0

Table 6. Distribution of square root iteration counts using $A = \text{RND}(30000)$ and $B = \text{RND}(30000)$ and modified first approximation.

NUMBER OF ITERATIONS	% OF NUMBERS TESTED
1	0
2	.01
3	.96
4	13.16
5	51.6
6	34.27
>= 7	0

Table 7. Distribution of square root iteration counts using $A = 1/\text{RND}(30000)$ and $B = \text{RND}(30000)$ and modified first approximation.

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Now that I am over the major hurdle, I want to make my computations even more efficient. My primary target is the parentheses which appear in line 120 of Listing 4.

I first experiment with alternate methods of writing the approximation equations. Fig. 2 shows some of the equation derivations. The first equation shows the value of the second approximation to the square root of X. In this equation, Y2 is the second approximation and Y1 is the first. As you can see, Y2 can be simply computed from Y1.

Continuing to the next approximation, Y3 is simply expressed in terms of Y2. In equation 3, the substitution is made for Y2. This equation reveals something very interesting. If

we assign the value of $(Y1 + X/Y1)$ to Z, then two successive approximations can be simply computed using the equations shown in Fig. 3.

The fact that we have condensed two approximations into this set of equations allows us to rewrite the square root routine as shown in Listing 5. Notice that only 3 iterations of the FOR-NEXT loop are required and that the parentheses are no longer included.

My final modification to increase the speed of the routine is shown in Listing 6. Here, the FOR-NEXT loop is replaced with three sets of equations which compute six approximations. This straight line coding requires more bytes of storage than the previous routine, but is slightly faster.

Listing 7 is a test of the various modifications which I have developed. It times them. Five subroutines are used for the various tests. The first subroutine is an immediate RETURN. I use this to determine how much time the main routine requires.

The four other routines are the normal square root routines from the Level I manual: the normal routine, using a modified

first approximation and a FOR-NEXT loop, the routine using the modified approximation equation, and the routine using the straight line coding of the ap-

$$Z = Y + X/Y$$

$$Y = Z/4 + X/Z$$

Fig. 3. Equations which combine two successive approximations to the square root of X.

$$Y2 = Y1 + \frac{1}{2} \left(\frac{X}{Y1} - Y1 \right) = \frac{1}{2} \left(\frac{X}{Y1} + Y1 \right)$$

$$Y3 = Y2 + \frac{1}{2} \left(\frac{X}{Y2} - Y2 \right) = \frac{1}{2} \left(\frac{X}{Y2} + Y2 \right)$$

$$= \frac{1}{2} \left[\frac{X}{\frac{1}{2} \left(\frac{X}{Y1} + Y1 \right)} + \frac{1}{2} \left(\frac{X}{Y1} + Y1 \right) \right]$$

$$= \frac{X}{\frac{X}{Y1} + Y1} + \frac{1}{4} \left(\frac{X}{Y1} + Y1 \right)$$

Fig. 2. Equations for the second and third approximations to the square root of X.

```
100 Y=A+B      COMPUTE APPROX. TO SQ. RT.
110 FOR K=1 TO 6 SET LOOP FOR SIX ITERATIONS
120 W=(X/Y-Y)*.5 COMPUTE ERROR
130 Y=Y+W      COMPUTE NEW APPROX.
140 NEXT K     LOOP
150 RET.
```

Listing 4. Modified square root routine using first approximation and FOR-NEXT loop.

```
100 Y=A+B      COMPUTE APPROX. TO SQ. RT.
110 FOR K=1 TO 3 SET LOOP FOR THREE ITERATIONS
120 Z=Y+X/Y     COMPUTE TWO APPROXIMATIONS
130 Y=Z/4 + X/Z USING MODIFIED EQUATIONS
140 NEXT K     LOOP
150 RET.
```

Listing 5. Revised square root routine using new first approximation and combined approximation equations. Note that only three loop iterations are required.

```
100 Y=A+B      COMPUTE APPROX. TO SQ. RT.
110 Z=Y+X/Y     USING THREE SETS OF
120 Y=Z/4 + X/Z MODIFIED EQUATIONS TO
130 Z=Y+X/Y     COMPUTE SIX
140 Y=Z/4 + X/Z APPROXIMATIONS
150 Z=Y+X/Y
160 Y=Z/4 + X/Z
170 RET.
```

Listing 6. Final square root routine which eliminates FOR-NEXT loop to maximize speed.

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proximation equations.

The results of the test are shown in Table 9. After subtracting the five second time of the main routine from the individual test times, the subroutine times can be compared. Execution speed is cut by a factor of more than eleven in going from the normal square root routine to my final specialized version. An improvement of this magnitude makes the work involved seem

well worth the trouble.

Problem 2

The second example I want to discuss involves an application in which my primary concern is program space and accuracy. Because of the limits of the TRS-80 to slightly more than 3500 bytes of usable storage, some programs can become pretty cramped.

My problem is to construct an

array which contains values of $\sin(X)$ over a range of 0 to $\pi/2$ (i.e., 0° - 90°). As in the case of the square root function, Level I BASIC does not contain the sine function. So, again I turn to the Level I manual's sine function subroutine. This routine is shown in Listing 8.

The basic sine routine calculation is performed using a power series approximation. Many mathematics text books

will show that $\sin(X)$ can be expressed as the infinite series:

$$\sin(X) = X - (X^3)/6! + (X^5)/5! - (X^7)/7! + (X^9)/9! - \dots$$

In the case of listing 8, the power series is computed using terms up to X^9 .

The Approach

When it becomes apparent that I need a few more bytes of storage for data, I examine the sine subroutine to see how many bytes I can squeeze out.

Computing the terms of the power series seems fairly repetitive and they seem to lend themselves to a FOR-NEXT loop. After several tries, I arrive at the routine shown in Listing 9.

The variable Q generates the terms of the power series. Each successive value of Q is computed by multiplying the previous value by $-X^2$ and dividing by the product of O, the loop index and (J-1). The variable Y keeps a running sum of the power series terms.

The savings in terms of storage amounts to about 25 bytes, which is enough to give me the breathing room I need. In fact, more savings are possible if unnecessary lines in the resulting sine routine are eliminated.

There is an added benefit to the modified sine routine. It is very simple and costs nothing in terms of storage, to obtain more accuracy. All that is necessary is to replace the nine in line 120 of Listing 9 with the value of the highest power term desired in the approximation. For example, 15 can be used.

The Final Test

Just to satisfy my curiosity, I decide to try the routine with more terms. I first try using 11 as the highest power term. The test routine is shown in Listing 10. It uses the parameter N to specify for the sine routine the highest power term in the approximation.

For each value of X, the sine routine is called twice—once using terms up to X^9 and once using terms up to X^{11} . The values obtained using each approximation are printed, and in

```

10   FOR I=1 TO 100
20   A=RND(30000): B=RND(30000)
30   X=A*A + B*B
40   GOSUB 100
50   NEXT I
60   PRINT "TIMING TEST COMPLETED"
70   END

```

Listing 7. Program used to test the efficiency of the various square root subroutines.

```

30370 REM *SIN* INPUT X IN DEGREES, OUTPUT Y
30371 REM ALSO USES Z INTERNALLY
30376 Z=ABS(X)/A: X=X*Z
30380 IF X>360 THEN X=X/360: X=(X-INT(X))*360
30390 IF X>90 THEN X=X/90: Y=INT(X): X=(X-Y)*90: ON Y GOTO
      30410, 30420, 30430
30400 X=X/57.29578: IF ABS(X)<2.4861E-4 THEN Y=0: RET.
30405 GOTO 30440
30410 X=90-X: GOTO 30400
30420 X=-X: GOTO 30400
30430 X=X-90: GOTO 30400
30440 Y=X-X*X*X/6+X*X*X*X/120-X*X*X*X*X/5040
30450 Y=Y+X*X*X*X*X*X/362880: IF Z=-1 THEN Y=-Y
30460 RET.

```

Listing 8. TRS-80 Level I manual sine function subroutine.

```

100   Q=X
110   Y=X
120   FOR J=3 TO 9 STEP 2
130   Q=-Q * X/J * X/(J-1)
140   Y=Y+Q
150   NEXT J
160   RETURN

```

Listing 9. Modified sine routine. The statements of this routine could be used to replace the power series expression on lines 30440 and 30450 of Listing 8.

```

10   FOR I=0 TO 32
20   X=1.5707963 * I/32
30   T=X
40   N=9: GOSUB 1000
50   A(1)=Y
60   X=T
70   N=11: GOSUB 1000
80   A(2)=Y
90   PRINT A(1),A(2)
100  IF A(1)<>A(2) P."DIFFERENT":P.
110  NEXT I
120  END

```

```

1000  Q=X
1010  Y=X
1020  FOR J=3 TO N STEP 2
1030  Q=-Q * X/J * X/(J-1)
1040  Y=Y+Q
1050  NEXT J
1060  RET.

```

Listing 10. Program used to test the effect upon $\sin(X)$ of different power series approximations.

NUMBER OF ITERATIONS % OF NUMBERS TESTED

<= 2	0
3	1
4	13.5
5	51.3
6	34.2
>= 7	0

Table 8. Distribution of square root iteration counts using $A = \text{RND}(0) * 1\text{E}10$ and $B = \text{RND}(0) * 1\text{E}10$ and modified first approximation.

SUBROUTINE USED	TOTAL TIME	TOTAL SUBROUTINE TIME
Immediate RETURN	5 sec.	—
Normal square root	107 sec.	102 sec.
Listing 4 routine	26 sec.	21 sec.
Listing 5 routine	16 sec.	11 sec.
Listing 6 routine	14 sec.	9 sec.

Table 9. Execution times of the various square root routines.

addition the two values are compared and a message is printed when the values are different.

The results of this test are both interesting and confusing. The approximation using the X^{**11} term is more accurate, as I had hoped. However, some results which appear to be the same when printed, produce a message which says that they are different.

I took this to mean that the internal binary representations of the values are slightly different. A portion of the results of the test is shown in Table 10. The confusing part of the results appears in the last computed value. The printed value displays 1.0000008, which contains more digits than I have ever been able to print for a number (the normal number of digits is six).

Next, I try adding another term to the power series approximation (i.e., $(X^{**13})/13!$)

but it produces no further improvement in accuracy.

Aside from these few puzzling occurrences, which I have yet to fully resolve, the results of my experiments are successful. I have achieved a savings in program space and an increase in accuracy.

The Moral

I hope that the two examples that I have presented will encourage you to find new and better ways to program routines in your applications. Don't assume that the method someone else uses is necessarily the best way for you. I'm sure that you too will discover that finding a better way is perhaps one of the most rewarding aspects of programming.

Most important of all, however, remember to make use of all your resources—including your computer—to improve your work. ■

VALUE OF SIN(X) USING X^{**9} TERM	VALUE OF SIN(X) USING X^{**11} TERM	TEST RESULT
.903989	.903898	different
.92388	.92388	different
.941544	.941544	different
.956941	.956941	different
.970032	.970031	different
.980786	.980785	different
.995186	.995185	different
.998798	.998795	different
1	1.0000008	different

Table 10. Partial listing of results from test program shown in Listing 10. Note that some values are not equal in a logical equivalence test even though the printed values are the same.

for the TRS-80 from Micro-Mega

CASSETTE CONTROL UNIT

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Ever find yourself with a blank screen wondering what your computer is up to? The Micro-Mega Monitor can tell you, for example: • If your CPU is in a loop with no exit, • When a long sort is nearing completion, or • If a key bounces during keyboard input. The CPU Monitor lets you listen to all CSAVES and CLOADs and will help you quickly find the correct recorder volume setting. If you have an expansion interface, you will always know whether the real-time clock is on or off because you can hear it.

The Micro-Mega CPU Monitor gives a voice to the Z-80 microprocessor in your TRS-80 by using AM radio circuitry to pick up the computational rhythms of the CPU, which are amplified and played through a loudspeaker. The pickup unit of the CPU Monitor, shown at left in the photo, goes under your TRS-80 keyboard. It is connected by a 36" cable to the speaker and control unit, which includes an on/off volume control and an LED "power-on" indicator. The Monitor is powered by an AC adapter, shown at right in the photo. No batteries are needed and no electrical connections to your TRS-80 are required.

By listening to the CPU Monitor, you will soon become familiar with the "personalities" of the programs you run and whether they are executing in a normal way. (See "Gaming Environment" below.)



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The eye-pleasing Green-Screen fits over the CRT of your TRS-80 Video Display and gives you improved contrast with reduced glare. You get bright, luminous green characters and graphics like those featured by very expensive CRT units.

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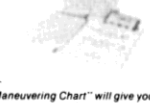
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Suddenly, you break out of hyperspace and your monitor displays the chilling sight of three Klingon Battle Cruisers floating on your screen! Their evil shapes glow in luminous green against the black void of space. Moments later, you hear the characteristic rasping sound of Klingon laser weapons, and, as you watch, high-energy beams come knitting toward the Enterprise in succession from each of the Klingon ships.

You have been hit! You hear the dismal sound of the damage control alarm as "DAMAGE TO WARP DRIVE" and "DAMAGE TO PHASERS" flash on your screen. The Klingons have stopped firing! The Enterprise is crippled, but your best weapon is still intact, and it's your turn now! You key in the command for photon torpedoes. As your screen again displays the position of the Klingon ships, you select a firing vector from your torpedo chart and key it in. Now you hear the buzz of your photon torpedo as you see it speeding toward a Klingon ship. It strikes him dead-center! As you watch, the Klingon Battle Cruiser disintegrates, accompanied by a satisfying crackling sound.

Does the above scenario sound far-fetched? Not at all. It's a small sample of what you will experience with Micro-Mega's Gaming Environment, which consists of • THE STAR TREK PACKAGE • THE GREEN-SCREEN and • THE CPU MONITOR. The fast-paced and dynamic action reflects the superb Star Trek III program together with the "Voyage Log" and "Torpedo Chart" of the Star Trek Package. All of the unique graphic displays are greatly enhanced by the Green-Screen. Finally, the uncanny sound effects are produced by the CPU Monitor, which faithfully picks up the FOR, NEXT loops and other CPU patterns, which create the distinctive siren sounds that accompany the ALERT and DAMAGE messages along with the harsher notes of the weapons salvos. Once you've tried it, you won't any longer be satisfied with silent computer games.

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Article storage and retrieval made easy.

Reference Library Index

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Tired of wading through a foot-high stack of computer publications looking for a specific article? Why not let your computer do it for you?

Better yet, put your micro to work building a cross-index of your entire inventory of computer publications—past, present and future.

The following program provides a system of cataloging,

storing and retrieving specific articles from your library. It is designed for the TRS-80 Level II with 16K.

Program Details

The program begins with a menu. They are as follows: A—instructions, B—retrieve list from internal data, C—read tape file and list and D—create data file on tape. Selection is made from the keyboard using IN-KEY\$ (lines 110 to 150). An error trap is located at line 150.

The instructions provide general information about the program.

The retrieve list from internal data option first prints the indexing format (Table 1) called

from subroutine 1000.

Next, the program asks for three inputs, used to retrieve selected articles from an internal data source beginning at line 3000. Enter the system number, the category number and the topic number in turn. These three codes are compared to each READ execution at line 250 for a positive match. If all three match the data provided, the article is printed by line 260.

By entering a 0 at line 190, the user can select all the articles pertaining to a specific system. This is accomplished at line 245 which branches directly to the PRINT line at 260.

A paging routine using the variable D as a counter is provided by lines 220, 260 and 270 through 300. The advantage of retrieving data from internal storage is speed; its disadvantage is the memory overhead required. I have listed a sample block of data starting at line 3000 which pertains to my own particular interests. A more comprehensive, although appreciably slower, option is discussed in the next paragraph.

The C option, "read tape file and list," allows the user to select and list articles from tape storage. The listing begins at line 440 and runs through line 660. This routine is essentially

the same as the internal option, but uses a tape file to provide data.

Once again, the indexing scheme is presented via subroutine 1000. The user enters the system, category and topic numbers that select articles at line 540.

If the user selects 0 in response to the category input, the program provides a complete listing of all articles filed under a specific system. Paging is provided at lines 560–580. An escape option is found at line 585 which allows the user to return to the menu during the paging routine.

Although this method of data storage is not as fast as an internal data bank, it is fast enough to scan an entire file of *Microcomputing* articles for a year's period in about 20 minutes. I've spent about twice that time digging out an article of interest from past issues, so the program results in definite time savings.

The final option is the routine that creates a tape data file. As with the rest of the program, it is self prompting. This segment begins at line 2000 and ends at line 2160. The indexing scheme is presented prior to input so you can assign index values to a given article.

SYSTEM	CATEGORY		
	1. HARDWARE	2. SOFTWARE	3. LANGUAGE
1. TRS-80	1. INTERFACE	1. BUSINESS	1. BASIC
2. KIM	2. CASSETTE	2. HOME	2. MACHINE
3. PET	3. DISK	3. GAMES	3. FORTRAN
4. APPLE	4. PRINTERS	4. GRAPHICS	4. PASCAL
5. HEATH	5. DISPLAYS	5. EDUCATIONAL	5. GENERAL
6. SWTP	6. I/O	6. GENERAL	
7. ALTAIR	7. KEYBOARDS		
8. ELF	8. SYNTHESIZERS		
9. GENERAL	9. GENERAL		

The user first enters the system number, then one of the three categories, and finally the specific topic from the category selected. If a complete listing of all articles for a given system is required, enter a 0 when asked to input the category.

Table 1

I found it very easy to load data using the table of contents of most magazines. Once I had loaded my entire library of publications, it only required about ten minutes to write each new issue's articles to tape storage.

Other modifications could be made to include disk storage in place of cassettes and line or screen printer options. As written, it should prove a more than adequate method of cross-indexing for the TRS-80 owner. ■

Program Listing

```

10 REM *** ARTICLE INDEXER ***
20 REM *** BY JAMES P. MORGAN SEP 79 ***
30 REM *** FOR TRS-80 LEVEL II, 16K ***
40 CLS: CLEAR 200
50 REM *** POKE STATEMENT FOR REVISION G, TRS-80 ***
60 POKE 16553,255
70 PRINT@20,"COMPUTER ARTICLE CROSS INDEXER":PRINT
80 PRINT"SELECT YOUR OPTION FROM THE FOLLOWING LIST. JU
ST
90 PRINT"PRESS THE KEY CORRESPONDING TO YOUR CHOICE.":P
RINT
100 PRINT"A=INSTRUCTIONS","B=RETRIVE LIST FROM INTERNAL
DATA"
105 PRINT"C=READ TAPE FILE AND LIST","D=CREATE DATA FIL
E ON TAPE"
110 B$=INKEY$:IF B$="" THEN 110
120 IF B$="A" THEN 1200
130 IF B$="B" THEN 170
140 IF B$="C" THEN 440
145 IF B$="D" THEN 160
150 CLS:PRINT"I DON'T UNDERSTAND. SELECT A,B,C,OR D.":G
OTO 80
160 GOTO 2000
170 RESTORE:CLS:GOSUB 1000
180 PRINT:INPUT"ENTER SYSTEM #";A1
190 INPUT"ENTER CATEGORY #. ENTER '0' TO SEE ALL SYSTEM
ARTICLES.":B1
195 IF B1=0 THEN 220
200 INPUT"ENTER TOPIC #";C1
210 REM *** READ AND PRINT DATA ***
220 D=0:CLS:PRINT@20,"SELECTED ARTICLES":PRINT
230 READ A,B,C,A$
240 IF A=0 THEN 310
245 IF A=A1 AND B1=0 THEN 260
250 IF A=A1 AND B=B1 AND C=C1 THEN 260 ELSE 230
260 PRINTA$:D=D+1
270 IF D=12 THEN 280 ELSE 230
280 PRINT"PRESS ANY KEY WHEN FINISHED WITH THIS PAGE."
290 B$=INKEY$:IF B$="" THEN 290
300 GOTO 220
310 RESTORE:PRINT:PRINT"OUT OF DATA. TYPE 'A' FOR NEW L
IST, 'B' TO INPUT ADDITIONAL
320 PRINT"DATA FROM TAPE, OR 'C' TO EXIT PROGRAM."
330 B$=INKEY$:IF B$="" THEN 330
340 IF B$="A" THEN 170
350 IF B$="B" THEN 450
360 IF B$="C" THEN 1500
370 CLS:PRINT"I DON'T UNDERSTAND. TRY AGAIN.":GOTO 310
440 PRINT"PREPARE RECORDER FOR DATA INPUT.":FORX=1TO150
$;NEXT
450 CLS:GOSUB 1000
460 PRINT:INPUT"ENTER SYSTEM #";A1
470 INPUT "ENTER CATEGORY #. ENTER '0' TO SEE ALL SYSTE
M ARTICLES.":B1
475 IF B1=0 THEN 510
480 INPUT "ENTER TOPIC #";C1
490 CLS
510 CLS:D=0:PRINT@20,"SELECTED ARTICLES":PRINT
520 INPUT@-1, A,B,C,A$
530 IF A=0 THEN 600
535 IF B1=0 AND A1=A THEN 550
540 IF A=A1 AND B=B1 AND C=C1 THEN 550 ELSE 520
550 PRINTA$:D=D+1
560 IF D=11 THEN 570 ELSE 520
570 PRINT:PRINT"HIT 'E' TO ESCAPE. HIT ANY KEY WHEN FIN
ISHED WITH THIS PAGE."
580 B$=INKEY$:IF B$="" THEN 580
585 IF B$="E" THEN 40
590 GOTO 510
600 PRINT"OUT OF DATA. TYPE 'A' FOR NEW LIST, 'B' TO IN
PUT ADDITIONAL
610 PRINT"DATA FROM ANOTHER TAPE, OR 'C' TO EXIT PROGRA
M."
620 B$=INKEY$:IF B$="" THEN 620
630 IF B$="A" THEN 450
640 IF B$="B" THEN 500
650 IF B$="C" THEN 1500
660 CLS:PRINT"I DON'T UNDERSTAND, TRY AGAIN.":GOTO 600
1000 CLS:PRINT"SYSTEM CATEGORY":PRIN
T
1010 PRINTTAB(16)"1. HARDWARE","2. SOFTWARE","3. LANGUA
GE"
1020 PRINT STRING$(60,"-")
1030 PRINT"1. TRS-80","1. INTERFACE","1. BUSINESS","1.
BASIC"

```

```

1040 PRINT"2. KIM","2. CASSETTE","2. HOME","2. MACHINE"
1050 PRINT"3. PET","3. DISC","3. GAMES","3. FORTRAN"
1060 PRINT"4. APPLE","4. PRINTERS","4. GRAPHICS","4. PA
SCAL"
1070 PRINT"5. HEATH","5. DISPLAYS","5. EDUCATIONAL","5.
GENERAL"
1080 PRINT"6. SWPT","6. i/o","6. GENERAL"
1090 PRINT"7. ALTAIR","7. KEYBOARDS"
1100 PRINT"8. ELF","8. SYNTHESIZERS"
1110 PRINT"9. GENERAL","9. GENERAL"
1120 RETURN
1200 REM *** INSTRUCTIONS ***
1210 CLS:PRINT"THIS PROGRAM PROVIDES YOU WITH A METHOD
OF STORING AND
1220 PRINT"RETRIVING SELECTED ARTICLES FROM YOUR REFERE
NCE LIBRARY.
1230 PRINT"YOU CAN STORE DATA INTERNALLY, CREATE A TAPE
DATA FILE, AND
1240 PRINT"SEARCH A TAPE FILE FOR SPECIFIC ARTICLES. TH
E KEY TO THE
1250 PRINT"PROGRAM KS AN INDEXING SYSTEM WHICH CATEGORI
ZES THE ARTICLES
1260 PRINT"SYSTEMATICALLY. INTERNAL DATA CAN BE STORED
FROM LINE
1270 PRINT"3000 ON. IT IS LIMITED ONLY BY THE MEMORY AV
AILABLE. THE
1280 PRINT"TAPE STORAGE METHOD IS UNLIMITED IN SPACE, B
UT IS A SLOWER
1290 PRINT"METHOD OF EXTRACTING DATA. THE PROGRAM IS SE
LF-PROMPTING
1300 PRINT"THROUGHOUT. JUST FOLLOW THE DIRECTIONS AND Y
OU SHOULD HAVE
1310 PRINT"NO TROUBLE CATELOGING YOUR ENTIRE LIBRARY."
1320 PRINT:PRINT"PRESS ANY KEY TO RETURN TO THE MENU."
1330 B$=INKEY$:IF B$=""THEN 1330
1340 CLS:GOTO70
1500 CLS:END
2000 REM *** CASSETTE DATA WRITE ***
2010 CLS:PRINT"CASSETTE DATA WRITE":PRINT
2020 PRINT"PREPARE CASSETTE AND TAPE FOR RECORDING."
2040 PRINT:PRINT"ENTER SYSTEM #, CATEGORY #, TOPIC #, A
ND ARTICLE TITLE,
2050 PRINT"PUBLICATION, DATE, AND PAGE. THE ENTIRE ARTI
CLE MUST BE
2055 PRINT"ENCLOSED IN QUO
2060 PRINT"MARK THE END OF A TAPE WITH A SERIES OF ZERO
S."
2061 PRINT"TYPE AN 'E' TO LEAVE THE WRITE ROUTINE. HIT
ANY KEY TO CONTINUE."
2062 B$=INKEY$:IF B$=""THEN 2062
2064 IF B$="E" THEN 2130
2066 CLS:GOSUB 1000
2070 PRINT:INPUT"SYSTEM #";A
2080 IF A=0 THEN 2130
2090 INPUT"CATEGORY, TOPIC #. SEPARATE WITH A COMMA";B,
C
2100 INPUT"TITLE, PUBLICATION, ISSUE, AND PAGE#--ALL IN
QUOTES";A$
2110 PRINT@-1, A,B,C,A$
2120 CLS:GOTO 2060
2130 CLS:PRINT"DATA WRITE COMPLETE. NOTE TAPE COUNTER A
ND LOG IN."
2140 PRINT"HIT ANY KEY TO RETURN TO THE MENU."
2150 B$=INKEY$:IF B$=""THEN 2150
2160 CLS:GOTO 70
3000 DATA 1,2,1,"INVENTORY,TRS-80,KB, FEB 79, P 64"
3010 DATA 9,2,2,"SIMPLER INTEREST, KB, FEB 79, P 116"
3020 DATA 9,2,1,"SIMPLER INTEREST, KB, FEB 79, P 116"
3030 DATA 1,2,3,"KEYBOARD INTERRUPT-TRS 80, KB, MAR 79,
P.128"
3040 DATA 1,1,9,"A LOOK AT 80 PERIPHERALS, KB, APR 79,
P. 22"
3050 DATA 1,2,3,"FREE SPEACH LESSONS, 80, KB, APR 79,P.
66"
3060 DATA 1,1,2,"TWIN CASSETTES FOR 80, KB, APR 79, P.
84"
3070 DATA 1,2,6,"A LOOK INSIDE THE 80, KB, APR 79, P. 1
20"
3080 DATA 1,2,1,"A TRS-80 CROSS INDEX, KB, MAY 79, P. 9
4"
3090 DATA 1,2,4,"GRAPHING WITH THE 80, KB, MAY 79, P. 1
00"
3100 DATA 1,1,4,"80 SELECTRIC WORD PROCESSOR, KB, JUN 7
9, P. 32"
3110 DATA 1,2,3,"SARGON MEETS 80, KB, JUL 79, P. 58"
3120 DATA 1,2,4,"GETTING THE MOST OUT OF 80, KB, JUL 79
, P. 112"
3130 DATA 1,1,2,"TELEPRINTER OUTPUT FOR 80, KB, AUG 79,
P. 38"
3140 DATA 1,3,2,"MACHINE LANG MONITOR FOR 80,KB, AUG 79
,P.114"
3150 DATA 1,1,9,"TRS SPEED UP, KB, SEP 79, P. 138"
3160 DATA 9,2,3,"SUPER MASTER MIND, KB, FEB 79, P.100"
3170 DATA 9,2,3,"CHESS PAWN, KB, MAR 79, P. 76"
3180 DATA 9,2,3,"TWO DIAMONDS, KB, APR 79, P. 115"
3190 DATA 9,2,3,"A GAME OF DARTS, KB, MAY 79, P. 78"
3200 DATA 9,2,4,"VECTOR GRAPHING TECH. KB, JUN 79, P. 6
4"
3210 DATA 9,2,4,"A CIRCULAR HANDLE ON GRAPHICS, KB,JUL
79,P.76"
3220 DATA 9,2,3,"NERVES, KB, AUG 79, P. 100"
3230 DATA 0,0,0,"0"

```


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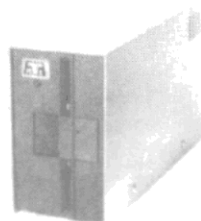
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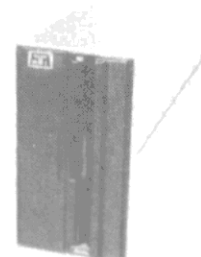
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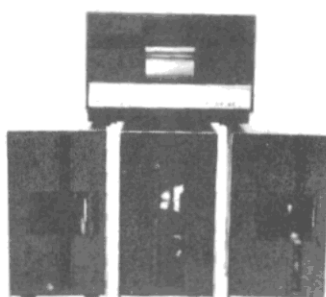
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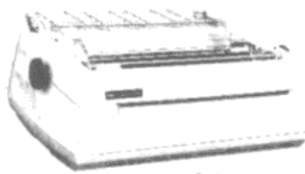
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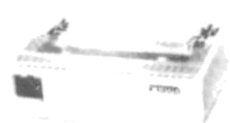
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As with 2.1, NEWDOS/80 relies on the TRSDOS and Disk Basic Reference Manual published by Radio Shack. NEWDOS/80 documentation supports its enhancements and upgrades only.

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Position Display

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Taking the lead from James J. Brennan, whose "Digital Time Clock" program appeared in the "Little Bits" column of *Kilobaud* in the January 1979 issue, I have written a subrou-

tine for the TRS-80. I call it POSDIS, an acronym for Position Display. It is useful and saves time.

POSDIS will let you: display a title in your program or have a message stand out from the rest of the text; to left and right justify the title; to position it on the screen by a PRINT@ statement; and finally, to graphically draw a border around it.

Type the Program

To show you the advantages of POSDIS, and to let the subroutine speak for itself, type in the routine (see Program Listing 1), SAVE it, and type the following program:

```
10 CLS
20 A$="THIS IS WHERE YOUR
  MESSAGE GOES"
30 GOSUB 30380
40 GOTO 40
```

Now, RUN the program. Notice that your message is automatically left and right justified, a graphic border is drawn around it for a stand-out effect, and the whole thing is displayed at the center of the screen. In a couple of seconds you have a nice looking display heading.

Here is what happened. First, you defined GOSUB A\$ as "This is where your message goes." Then you decided you wanted the message to appear at the center of the screen, so you entered GOSUB 30380, which is the routine that transported the

message, justified it, sent it to line 30900 to calculate the graphic border and drew it before returning to the next line in your program (in this case line 40).

Suppose you want the message at the top of the screen. Just retype line 30 GOSUB 30140. If you want the message at the bottom of the screen, retype line 30 GOSUB 30620. Try it and see what happens.

The subroutine at lines 30140 through 30620 will print your message at 13 different screen display positions and must follow your A\$ message as shown in the sample program.

Three Subroutines

Three other subroutines have been added. Two timing loop series for an automatic effect, and a routine, which will hold the display until the keyboard operator presses ENTER.

For example, retype line 40 GOSUB 30680. Run the program and notice that the message appears with "PRESS ENTER TO CONTINUE" added to the bottom of the screen.

If you want an automatic effect, retype line 40 GOSUB 30820 and add line 50 A\$="THIS IS WHERE A SECOND MESSAGE GOES" : GOSUB 30380 : GOSUB 30680.

By using various screen display positions, timing loops, and PRESS ENTER TO CONTINUE your next program will have a professional look, ease of operation and simplicity. ■

Program Listing

```
30000 '*****
30001 '***
30010 ' "POSDIS" SUBROUTINE - VERSION 1.0
30020 '
30030 '
30040 '
30050 '*****
30060 '
30070 '
30080 REM ** SUBROUTINE LINES TO LEFT AND RIGHT JUSTIFY
30090 REM ** <A$> AT 13 DIFFERENT SCREEN POSITIONS
30100 '
30110 '
30120 ' JUSTIFY <A$> AND DISPLAY AT SCREEN POSITION 64
30130 '
30140 P=32-LEN(A$)/2+64:TH=0:BH=0:LV=32-LEN(A$)/2:RV=32
+LEN(A$)/2+64:GOSUB30900:PRINT@P,A$;:RETURN
30150 '
30160 ' JUSTIFY <A$> AND DISPLAY AT SCREEN POSITION 128
30170 '
30180 P=32-LEN(A$)/2+128:TH=3:BH=11:LV=32-LEN(A$)/2:RV=
32+LEN(A$)/2+64:GOSUB30900:PRINT@P,A$;:RETURN
30190 '
30200 ' JUSTIFY <A$> AND DISPLAY AT SCREEN POSITION 192
30210 '
30220 P=32-LEN(A$)/2+192:TH=6:BH=14:LV=32-LEN(A$)/2:RV=
32+LEN(A$)/2+64:GOSUB30900:PRINT@P,A$;:RETURN
30230 '
30240 ' JUSTIFY <A$> AND DISPLAY AT SCREEN POSITION 256
30250 '
30260 P=32-LEN(A$)/2+256:TH=9:BH=17:LV=32-LEN(A$)/2:RV=
32+LEN(A$)/2+64:GOSUB30900:PRINT@P,A$;:RETURN
30270 '
30280 ' JUSTIFY <A$> AND DISPLAY AT SCREEN POSITION 320
30290 '
30300 P=32-LEN(A$)/2+320:TH=12:BH=20:LV=32-LEN(A$)/2:RV=
32+LEN(A$)/2+64:GOSUB30900:PRINT@P,A$;:RETURN
30310 '
30320 ' JUSTIFY <A$> AND DISPLAY AT SCREEN POSITION 384
30330 '
30340 P=32-LEN(A$)/2+384:TH=15:BH=23:LV=32-LEN(A$)/2:RV=
32+LEN(A$)/2+64:GOSUB30900:PRINT@P,A$;:RETURN
30350 '
30360 ' JUSTIFY <A$> AND DISPLAY AT SCREEN POSITION 448
(SCREEN CENTER)
30370 '
30380 P=32-LEN(A$)/2+448:TH=18:BH=26:LV=32-LEN(A$)/2:RV=
32+LEN(A$)/2+64:GOSUB30900:PRINT@P,A$;:RETURN
```



```

30390 '
30400 ' JUSTIFY <AS> AND DISPLAY AT SCREEN POSITION 512
30410 '
30420 P=32-LEN(AS)/2+512:TH=21:BH=29:LV=32-LEN(AS)/2:RV
=32+LEN(AS)/2+64:GOSUB30900:PRINT@P,AS;:RETURN
30430 '
30440 ' JUSTIFY <AS> AND DISPLAY AT SCREEN POSITION 576
30450 '
30460 P=32-LEN(AS)/2+576:TH=24:BH=32:LV=32-LEN(AS)/2:RV
=32+LEN(AS)/2+64:GOSUB30900:PRINT@P,AS;:RETURN
30470 '
30480 ' JUSTIFY <AS> AND DISPLAY AT SCREEN POSITION 640
30490 '
30500 P=32-LEN(AS)/2+640:TH=27:BH=35:LV=32-LEN(AS)/2:RV
=32+LEN(AS)/2+64:GOSUB30900:PRINT@P,AS;:RETURN
30510 '
30520 ' JUSTIFY <AS> AND DISPLAY AT SCREEN POSITION 704
30530 '
30540 P=32-LEN(AS)/2+704:TH=30:BH=38:LV=32-LEN(AS)/2:RV
=32+LEN(AS)/2+64:GOSUB30900:PRINT@P,AS;:RETURN
30550 '
30560 ' JUSTIFY <AS> AND DISPLAY AT SCREEN POSITION 768
30570 '
30580 P=32-LEN(AS)/2+768:TH=33:BH=41:LV=32-LEN(AS)/2:RV
=32+LEN(AS)/2+64:GOSUB30900:PRINT@P,AS;:RETURN
30590 '
30600 ' JUSTIFY <AS> AND DISPLAY AT SCREEN POSITION 832
30610 '
30620 P=32-LEN(AS)/2+832:TH=36:BH=44:LV=32-LEN(AS)/2:RV
=32+LEN(AS)/2+64:GOSUB30900:PRINT@P,AS;:RETURN

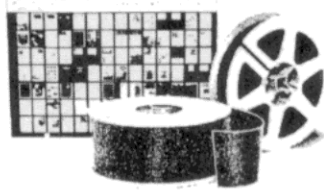
```

```

30630 '
30640 '
30650 '
30660 REM ** ROUTINE TO HALT DISPLAY UNTIL OPERATOR INP
UT **
30670 '
30680 PRINT@32-25/2+960,"PRESS <ENTER> TO CONTINUE";:IN
PUTAS:CLS:RETURN
30690 '
30700 '
30710 '
30720 REM ** TIMING LOOP **
30730 '
30740 FOR X=1 TO 500: NEXT X: RETURN
30750 FOR X=1 TO 1000: NEXT X: RETURN
30760 FOR X=1 TO 1500: NEXT X: RETURN
30770 FOR X=1 TO 2000: NEXT X: RETURN
30780 '
30790 REM ** TIMING LOOP THEN CLOSE SCREEN <CLS> **
30800 '
30810 FOR X=1 TO 500: NEXT X: CLS: RETURN
30820 FOR X=1 TO 1000: NEXT X: CLS: RETURN
30830 FOR X=1 TO 1500: NEXT X: CLS: RETURN
30840 FOR X=1 TO 2000: NEXT X: CLS: RETURN
30850 '
30860 '
30870 '
30880 REM ** SUBROUTINE TO DRAW BORDER AROUND <AS> **
30890 '
30900 FOR X=LV TO RV:SET(X,TH):SET(X,BH)::NEXT X:FOR Y=
TH TO BH:SET(LV,Y):SET(RV,Y):NEXT Y:RETURN

```

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A case for string packing.

Stringy Machine Code

David D. Grimes
12949 W. Montana Dr.
Lakewood, CO 80228

For BASIC programs with machine language routines you no longer need to load a separate SYSTEM tape, specify a power up MEMORY SIZE or modify programs for different RAM sizes.

String packing takes care of these problems, making it possible to wed BASIC and machine languages.

The string packing technique for embedding machine language code in BASIC programs offers exciting possibilities and convenience to TRS-80 users.

Eliminates SYSTEM Tape

For example, printing game instructions on the screen in machine language is difficult and tedious, but in BASIC it's

easy. Computing generations in the game of Life can take thirty seconds or more in BASIC, while it takes only fractions of a second in machine language.

Having both languages in one program eliminates the need for SYSTEM tapes, because all data formerly on the SYSTEM tape can be CSAVED as part of the BASIC program, and the BASIC program knows exactly where to find the machine language in RAM, via the USR command.

Furthermore, since the machine language is stored as part of the BASIC program, it isn't going to overlay itself, so no upper RAM need be saved at power-up time.

Let's examine a practical application using string packing—an audible prompt. The audible prompt (beep) is used when a program needs keyboard input, when an error is detected, or when a program has come to the end of its job, etc.

Listing 1 is a listing of a short BASIC program that packs a 24 byte machine language pro-

gram into \$\$\$. The BASIC portion of the program controls the flow and execution, the machine language contributes only the beep. The audio signal is output to the plug, which normally goes to the AUX jack in the cassette recorder. This plug must connect with an audio amplifier, such as a Radio Shack Microsonic Speaker Amplifier (277-1008).

Table 1 gives a detailed description of the packing of the machine language routine. Note that it is executed only once, not each time that a prompt is sounded.

The Program

Lines 120-210 (Listing 1) set up a prompt for keyboard input. If no entry is made, a prompt sounds every four seconds. If an incorrect entry is made, the prompt sounds instantly.

Line 150 jumps to the packed subroutine, which generates the sound and then returns to BASIC at the next line. If the correct entry is made, the program

```

10 POKE 16553,255      'FIXES ROM DATA READ BUG
20 $$="THIS STRING LENGTH IS 24"
30 I=VARPTR($$)
40 JJ=PEEK(I+2)*256+PEEK(I+1)
50 IF JJ>32767 THEN JJ=-1*(65536-JJ)
60 FOR P=JJ TO JJ+23
70 READ D:POKE P,D:NEXT
80 DATA 205,127,10,14,60,65,62,01,
        211,255,16,254,65,60,
        211,255,16,254,43,124,181,32,238,201
90 POKE 16526,PEEK(I+1):POKE 16527,PEEK(I+2)
100 '
110 '
120 CLS
130 PRINT@0,"ENTER 'Y' OR 'N' ?"
140 IF DE<100 GOTO 170
150 X=USR(100)          'I BEEP HERE
160 DE=0
170 Z$=INKEY$
180 IF Z$="" THEN DE=DE+1:GOTO 130
190 PRINTZ$
200 IF Z$<>"Y" AND Z$<>"N" THEN 150
210 PRINT"THANK YOU !"
220 FOR DE=1 TO 500:NEXT
300 PRINT"I AM SIMULATING BEING HARD AT WORK ON A PROGR
AM.
310 PRINT"I WILL TELL YOU WHEN I HAVE FINISHED BY 'BEEP
ING'."
320 PRINT"YOU CAN STOP THE BEEP AND RETURN TO THE LEVEL
II
330 PRINT">READY BY PRESSING ANY KEY.
340 FOR DE=1 TO 5000:NEXT
350 X=USR(200)          'I BEEP HERE
360 FOR DE=1 TO 500
370 AS=INKEY$
380 IF AS<>" " THEN 410
390 NEXT
400 GOTO 350
410 END

```

Program Listing 1

Line	Description
10	Fixes ROM bug for reading DATA statements
20	Defines string of sufficient length into which machine language will be packed
30	Finds address of \$\$ information block
40	Computes decimal address of location of \$\$
50	Adjustment for RAM sizes up to 16K
60	Sets up loop
70	POKEs DATA into string
80	Machine language code in decimal
90	POKEs address of \$\$ into USR area, so that BASIC program can find it when USR call is made

Table 1. Subroutine Initializer

continues to line 210.

Lines 300-410 could, as in this case, be put at the end of any program to announce an audible end of job. The beep continues every few seconds until any key is depressed.

Once the program is working, any attempt to LIST it causes the screen to roll and looks somewhat like a bad load from tape. This is because BASIC is attempting to print something which it does not normally see, namely machine language in \$\$.

At this point, you should CSAVE the program, because we are going to delete part of it to save RAM. After the program has run successfully, the DATA in line 80 are obviously packed into \$\$ as a working machine language subroutine, so lines 40 through 80 are redundant and can be deleted.

When we CLOAD the program again, the subroutine will be in \$\$, just as it is now and needn't be packed again. After deleting lines 40 through 80, CSAVE the program again (see Restriction).

tions).

The argument in the USR command determines the length of the tone. Larger values (up to 32767) cause longer beeps. A value of more than 1000 or so causes a very long tone.

The pitch is controlled by the fifth DATA element in line 80. In the example it is 60. Larger values give a lower pitch. The value must not exceed 255.

Restrictions

1. DATA elements to be packed must not have the value 0 or 34. Either terminates the string when packed.

2. If lines 40 through 80 are deleted after the string is packed, certain conditions can cause the program to bomb; if you modify the BASIC program, for example. This can be avoided by not deleting the string packing code until a final version of the program is produced, or by not deleting the lines at all, if RAM use is not a consideration. ■

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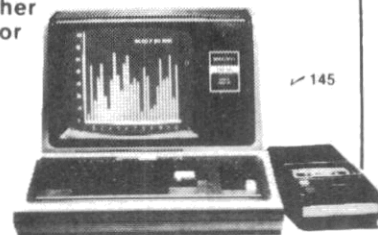
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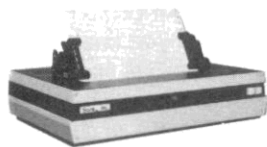
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It's magic, absolute magic! A 12" x 6" x 4" box of capacitors, resistors, transistors and integrated circuits is talking to me in plain English. Not only is it talking, but it says anything that I ask it to, including some very funny sound effects.

I suppose my engineering background and our nation's ability to put men on the moon should have prepared me for this. Nonetheless, I am still amazed at the marvels in our growing level of consumer technology.

Loading the Demo Tape

I picked up one of Radio Shack's Voice Synthesizers, in spite of its \$399 price tag.

The Voice Synthesizer is a completely self-contained unit.

Like its host, the TRS-80, it uses a separate in-line step-down transformer. The synthesizer can be used on any Level I or II TRS-80 and attaches by a ribbon cable and 40-pin connector expansion port.

For those of you who have the expansion interface, the synthesizer connects to your parallel interface port on the left side of the unit. Once connected, you turn on the synthesizer, adjust the volume and begin programming.

Radio Shack was thoughtful enough to include a demonstration cassette tape with the synthesizer. Unfortunately, the manual I received made no mention of the cassette! However, by increasing the tape player's volume level to about 6.5, the cassette finally loaded.

After typing RUN, the TRS-80 started talking! The program takes several minutes, during which time you get a good idea of what synthesized speech sounds like, as well as how it is structured in a program. While the audio output is quite intelligible, the synthesizer produces a stereotype computer sound much like the Battle Star Galactica's Cylons.

Using the Synthesizer

While the manual that accompanies the synthesizer contains

only 13 pages, it provides adequate information for anyone who can program in BASIC to be able to use the synthesizer. Radio Shack's approach to programming their synthesizer is interesting.

First of all, they do all the programming in BASIC. Although this may not be the most efficient method, it certainly makes using the synthesizer very simple.

Secondly, they used 32 bytes of the video monitor's memory map to store the synthesized voice message. The storage is only temporary, in that the synthesizer contains a 32-byte buffer that is filled from the lower portion of the video monitor's memory. Once the synthesizer's buffer is loaded, the memory can be erased or written over. This is done so rapidly that you can't even see what is happening on the monitor.

After the voice programming has been transferred to the synthesizer, the TRS-80 continues with its program, while the synthesizer is speaking. This allows for some very exciting graphics. For example, the rockets may fizzle as your Lunar Lander is in motion. Or a spelling program can draw a word as the synthesizer pronounces it. Business programs can verbally explain

sales, as the computer draws a graph.

How does the synthesizer know when it has a message to relate? Based on the program description, it appears that the voice synthesizer acts as a 32-byte block of memory paralleling the video monitor locations 16352D to 16383D. This block, referred to as a "window" in the instruction manual, is opened and closed by the control character, ?.

When a ? appears in memory locations 16352D to 16383D, the synthesizer opens or closes its window. An LED on the synthesizer lets you know if the window is open or closed.

Once the window is opened, any character or characters appearing between the window locations is copied into the synthesizer's buffer, and the synthesizer produces the character's phonetic sounds.

Maximum message length is 32 characters at a time. Depending on the words used, 32 characters produces from one to five seconds of speech. If you desire a longer message, you can string together several groups of characters, separated by a software time delay, allowing the first segment of speech to be completed before the second begins.

This sequencing can be done

```

5 REM *** SET UP PROMPTING PHRASE "PLEASE ENTER YES OR NO" ***
10 AS = "PL.EZ JNTR V43SS O/ NBOU"
15 REM *** PLACE PHRASE IN SYNTHESIZER ***
20 PRINT@992, "? "AS" ?"
25 REM *** CLEAR SCREEN "WINDOW" ***
30 PRINT@992, "

```

Program Listing 1.

indefinitely to produce as long a message as your memory allows. Based on an average of three seconds for each group of 32 characters, 1K of memory produces approximately one and a half minutes of speech. This can be increased substantially by using a "dictionary array" of commonly used words.

Add Sound to Your Character

In printed text, a single symbol is called an ASCII character. The "characters" used in the spoken message are called phonemes (fō-nēms). A phoneme is a single unit of sound. It is the combination of phonemes that produces the words the voice synthesizer pronounces.

The TRS-80 Voice Synthesizer contains 62 phonemes that can be combined to pronounce virtually any word in the English language, as well as some foreign words and phrases.

The correct programming method for the synthesizer is to type the ASCII character that represents the phonetic sound desired, for example: TEE ;R3SS @•&DY VO85&SS SIN = 85;&Z/ is TRS-80 Voice Synthesizer.

The manual includes a table that cross references the phoneme symbol and its ASCII character. The manual suggests that you sound out the word you are trying to program and then select the correct phonemes to use. I have found that this works quite well but still requires some trial and error experimentation.

While the manual does provide a dictionary, with correct phoneme constructions, it includes only 34 words.

You can also cross-reference any dictionary's phonetic symbols with the manual's phoneme symbols/ASCII characters.

Using a Dictionary

I found some phonetic symbols that could not be referenced as single phonemes. These sounds, such as the long *i*, are represented as diphthongs, a combination of vowel phonemes. With a little experimentation, you soon find that by changing or adding a single phoneme you can also create different inflections, such as the word beer, which can be coded BEER or BEIR.

BASIC Programming

Program Listing 1 demonstrates how simple it is to add verbal responses to a BASIC program. It prompts you to enter yes or no. To change the message, it is necessary to change only the AS. Lines 20 and 30 can be a called subroutine using various AS messages.

Program Listing 2 can be used to experiment with different phoneme structures. Be careful to keep the number of phonemes to less than 28.

If you should type more than 28, the LED on the synthesizer stays lit. This is because the second ? was truncated from the buffer, and the synthesizer's window was not closed.

If this happens, just press the

```

10 CLS
20 PRINT@404, "ENTER PHONETIC PHRASE"
30 PRINT@464, "-----"
40 PRINT@464, "
50 INPUT AS
60 GOSUB 100
70 GOTO 10
100 PRINT@992, "? "AS" ?"
110 PRINT@992, "
120 RETURN

```

Program Listing 2.

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? key and ENTER, and the window closes. The reason for this is that the open window sees the ? as a toggle off-control character. Remember that the first ? toggles the window open and a second toggles the window closed. There are several other examples of useful subroutines included in the synthesizer's manual.

A list of potential applications is included in the manual. These include:

- Computer-Aided Instruction
- Intrusion — Fire Alarm
- Games
- Talking Clock
- Blind User's Terminal
- Verbally Impaired Prosthetic Aid
- Home Environment Audio Response (I programmed mine to ask for a beer!)
- Computer — Phone Voice Interface

But once you've used the Synthesizer, you're going to be intrigued with its other possibilities. How about a verbal calculator? Or a typing instruction program?

Finding fault with the TRS-80 synthesizer is like telling Henry Ford that his first automobile rode rough. True, it is a marvelous invention, but several areas can be improved. The first is the monotone computer sound. It would be nice to have an option for changing the pitch.

Secondly, some control is needed over the speed. I can envision a version of the synthesizer that will be able to sing, as well as speak.

Several phonemes do not really sound as one would expect. The *g* sounds almost identical to the *d* and causes words like *gig* to sound more like *deed*. The *L* has what I call an Elmer Fudd sound, that is, a soft type *L*, rather than a hard *L*. The *K* also has a tendency to sound a little soft.

While some of these sounds are not perfect, the synthesized voice for the most part is very intelligible. I'd recommend the synthesizer for most any application where an audible prompt is desired. ■

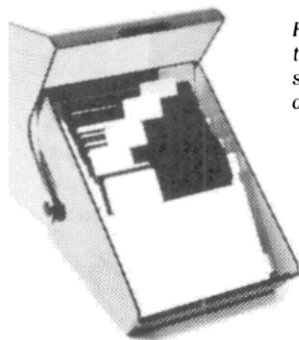
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Traditional math flash cards have always been a very useful tool for young students in learning math fundamentals. The math flash card program here helps the student practice and learn on his own without a tutor. The program creates all the requisites of a conventional math drill: random addition or subtraction problems presented with bold, easily readable numerals; a set response time limit; positive reinforcement for correct answers, and a chance to redo an incorrectly answered problem.

For each problem, two variables between 0 and 49 are selected. These variables are either added or subtracted on a random basis and then presented as the problem. The variables' upper limit of 49 restricts the answer to a two digit value.

After each set of nine prob-

lems is completed, an interim score is presented. If the student chooses to continue, the next set of nine problems is presented. If the student chooses not to continue, a total score for all problems attempted is provided.

The variables are selected so as to minimize repetition of problems and to maximize exposure to all possibilities. If, for example, the student is encountering specific difficulties, the program can be easily modified to present a specific set of problems. The program presents up to 81 different problems per run.

A Typical RUN

When the program is RUN, the message "GET READY—HERE WE GO!" appears as the random variables are selected. The screen then clears, and the first problem is displayed (ex: $14 + 23 =$) in two-inch high numerals. The student has approximately four seconds to enter an answer. The entered answer is displayed to the right of the equals sign in normal height ($\frac{1}{4}$ inch) numerals. Since the answer is entered via the INKEY\$ function, the student need only press the appropriate numeric

keys to input an answer.

A correct answer causes the reinforcement message "*** VERY GOOD***" to appear above the problem. If the student's answer is incorrect, it is removed from the screen and the message "XX IS WRONG. THE RIGHT ANSWER IS:" is displayed in the upper left hand corner of the screen.

At the same time, the correct answer is displayed to the right of the equals sign in bold (two-inch high) numerals. In either event, the problem remains on the screen for an additional three seconds. A correct answer allows a new problem to be displayed. For an incorrect answer, the same problem is repeated, giving the student another chance to answer correctly.

If the student does not respond to any problem in the allotted four seconds, the message "TIME'S UP" appears in the upper left hand corner of the screen and the correct answer is displayed in bold numerals. A "TIME'S UP" situation is treated as an incorrect answer.

If the student does not provide the correct answer in two tries, an incorrect response is scored. At the end of nine prob-

lems, the screen clears and the message "YOU GOT X RIGHT OUT OF 9 TRIES THIS TIME. WANT TO TRY AGAIN (YES OR NO)" is displayed.

If the student responds with lems, the screen clears and the message "YOU GOT X RIGHT OUT OF 9 TRIES THIS TIME. WANT TO TRY AGAIN (YES OR NO)" is displayed.

About The Program

Fully half of the program consists of subroutines to create the bold numerals, plus, minus and equals signs (Lines 1000 through 2200). These subroutines use the variable S to position the numerals on the screen. S is initially set to 15682 in Line 65 and is continually readjusted during the program to allow the problem to be serially presented (one character after another). The program automatically adjusts for single or double digit variables/answers so that gaps are not left in the presentation.

The program can be easily customized to a specific student's needs in a number of areas. For the very young student, the variables can be limited to a single digit (0 to 9) by changing the statement A(K) =

RND(49) in line 10 to A(K) = RND(9) and B(K) = RND(49) in line 30 to B(K) = RND(9).

The response time allowed for each problem can be adjusted by varying the FOR-NEXT loop in line 140. As shown, the keyboard is scanned for a response 25 times (FOR M = 1 TO 25). Increasing the loop increases the allowable response time—decreasing it shortens the time allowed.

If a specific set of problems is desired instead of the presently available random selection, lines 10 through 40 can be deleted and replaced with:

```
10 DATA A,B,C,D,E,F,G,H,I,J,K,L,M,N,O,P,
  Q,R
20 FOR I=1 TO 9: READ A(I):READ B(I):
  NEXT I
(with A through R being numbers you
select)
```

With this modification, A,C,E,G,I,K,M,O and Q will be the numerals of the first variable and B,D,F,H,J,L,N,P and R will be the numerals of the second variable. For example, if A = 19 would be 19 + 43 (or 43 - 19 if subtraction was randomly selected). If only addition or only subtraction is desired, lines 60 and 70 may be deleted and replaced with 60 C = A + B (for addition, or) 60 C = A - B (for subtraction).

It is possible to multiply and/or divide. However, special care must be taken such that the variable produce an integer answer that is no larger than 99. In addition, appropriate subroutines for the times (x) and divide (+) signs would need to be added. ■

Program Listing.

```
1 REM*****
2 REM*****
3 REM***** MATH FLASH CARDS
4 REM*****
5 REM***** A PROGRAM BY
6 REM***** JIM BARBARELLO
7 REM*****
8 REM*****
9 REM
10 CLS:PRINT"GET READY - - HERE WE GO!":RANDOM:FOR K=1 TO 9:A(K)=
  RND(49)
20 FOR J=0 TO K-1:IF A(K)=A(J) THEN K=K-1:NEXT K ELSE NEXT J,K
30 FOR K=1 TO 9:B(K)=RND(49)
40 FOR J=0 TO K-1:IF B(K)=B(J) THEN K=K-1:NEXT K ELSE NEXT J,K
50 FOR K=1 TO 9
60 FOR J=1 TO 9:IF CT=0 THEN D=RND(2)
65 AS="":BS="":S=15682:CLS:A=A(K):B=B(J):C=0:F=0
70 IF D=1 THEN C=A+B ELSE C=A-B
75 IF C<0 THEN A=B(J):B=A(K):C=A-B
80 IF A>9 THEN W=INT(A/10):Y=A-W*10 ELSE Y=A:S=S-8
85 ON W GOSUB 1000,1100,1200,1300,1400,1500,1600,1700,1800
90 S=S+8
95 ON Y GOSUB 1000,1100,1200,1300,1400,1500,1600,1700,1800
100 IF Y=0 THEN GOSUB 100
105 ON D GOSUB 2000,2100,2200,2300,2400,2500,2600,2700,2800
110 S=S+16:IF B>9 THEN W=INT(B/10):ON W GOSUB 1000,1100,1200,1300,
  1400,1500,1600,1700,1800
115 IF B>9 THEN Y=B-W*10 ELSE Y=B:S=S-8
120 S=S+8:ON Y GOSUB 1000,1100,1200,1300,1400,1500,1600,1700,1800
125 IF Y=0 THEN GOSUB 100
130 S=S-17:GOSUB 2200:S=S-1:W=0:Y=0:AS=INKEY$
140 FOR M=1 TO 25
150 AS=INKEY$
160 IF AS="" THEN 170 ELSE 200
170 FOR L=1 TO 50:NEXT L,M
180 PRINT@ 498," ":PRINT@ 0,"TIME'S UP"
190 CT = CT+1:GOTO 240
200 IF C>9 AND BS="" THEN BS=AS:M=5:PRINT@ 498,BS:NEXT M:ELSE PR
  INT@ 499,AS;
210 G=VAL(AS)+VAL(BS)*10:IF G=C THEN CT=0:PRINT@ 84,"** VERY GOOD
  **":GOTO 290
220 IF G<>C THEN PRINT@ 0,G;" IS WRONG. THE RIGHT ANSWER IS":CT=C
  T+1:PRINT@498," ":GOTO 240
230 CT=0
240 S=S+36
250 IF C=0 THEN GOSUB 1900:GOTO 290
260 IF C>9 THEN W=INT(C/10):Y=C-W*10 ELSE Y=C:S=S-8
270 ON W GOSUB 1000,1100,1200,1300,1400,1500,1600,1700,1800
275 S=S+8
280 ON Y GOSUB 1000,1100,1200,1300,1400,1500,1600,1700,1800
285 IF Y=0 THEN GOSUB 1900
290 FOR N=1 TO 750:NEXT N
300 IF CT=0 THEN TTL=TTL+1:NEXT J:GOTO 330
310 IF CT<2 THEN J=J-1:NEXT J:GOTO 330
320 CT=0:NEXT J:GOTO 330
330 CLS:PRINT"YOU GOT IT!";TTL;" RIGHT OUT OF 9 TRIES THIS TIME":TTL=T
  L+TTL:TTL=0
340 PRINT:INPUT"WANT TO TRY AGAIN (YES OR NO)";BLS
350 IF LEFT$(BLS,1)="Y" THEN NEXT K
360 IF LEFT$(BLS,1)="N" THEN CLS:PRINT"YOUR TOTAL IS":TTL;" RIGHT
  OUT OF":K*9;" TRIES. BYE!":END
370 GOTO 340
1000 REM** ONE
1010 FOR I=0 TO 4
1020 POKE S+I*64,191:POKE S+1+I*64,191:NEXT
1030 POKE S+62,191:FOR I=1 TO 6:POKE S+253+I,191:NEXT
```

```
1040 RETURN
1100 REM** TWO
1110 FOR I=-2 TO 3
1120 POKE S+I,191:POKE S+128+I,191:POKE S+256+I,191:NEXT
1130 POKE S+67,191:POKE S+190,191
1140 RETURN
1200 REM** THREE
1210 FOR I=-2 TO 3
1220 POKE S+I,191:POKE S+128+I,191:POKE S+256+I,191:NEXT
1230 POKE S+67,191:POKE S+195,191
1240 RETURN
1300 REM** FOUR
1310 POKE S+128,191:POKE S+129,191
1320 FOR I=0 TO 4:POKE S+2+I*64,191:POKE S+3+I*64,191:NEXT
1330 FOR I=0 TO 2:POKE S-2+I*64,191:POKE S-1+I*64,191:NEXT
1340 RETURN
1400 REM** FIVE
1410 FOR I=-2 TO 3
1420 POKE S+I,191:POKE S+128+I,191:POKE S+256+I,191:NEXT
1430 POKE S+62,191:POKE S+195,191
1440 RETURN
1500 REM** SIX
1510 FOR I=-2 TO 3
1520 POKE S+I,191:POKE S+128+I,191:POKE S+256+I,191:NEXT
1530 POKE S+62,191:POKE S+190,191:POKE S+195,191
1540 RETURN
1600 REM** SEVEN
1610 FOR I=-2 TO 3:POKE S+I,191:NEXT
1620 FOR I=0 TO 4:POKE S+2+I*64,191:POKE S+3+I*64,191:NEXT
1630 RETURN
1700 REM** EIGHT
1710 FOR I=-2 TO 3
1720 POKE S+I,191:POKE S+128+I,191:POKE S+256+I,191:NEXT
1730 POKE S+62,191:POKE S+67,191:POKE S+190,191:POKE S+195,191
1740 RETURN
1800 REM** NINE
1810 FOR I=-2 TO 3
1820 POKE S+I,191:POKE S+128+I,191:POKE S+256+I,191:NEXT
1830 FOR I=0 TO 4:POKE S+3+I*64,191:NEXT
1840 POKE S+62,191
1850 RETURN
1900 REM** ZERO
1910 FOR I=-2 TO 3
1920 POKE S+I,191:POKE S+256+I,191:NEXT
1930 FOR I=0 TO 4:POKE S-2+I*64,191:POKE S+3+I*64,191:NEXT
1940 RETURN
2000 REM** PLUS SIGN
2010 FOR I=1 TO 3
2020 POKE S+8+I*64,191:POKE S+9+I*64,191:NEXT
2030 FOR I=0 TO 5:POKE S+134+I,191:NEXT
2040 RETURN
2100 REM** MINUS SIGN
2110 FOR I=0 TO 5:POKE S+134+I,191:NEXT
2120 RETURN
2200 REM** EQUALS SIGN
2210 FOR I=0 TO 5:POKE S+88+I,191:POKE S+216+I,191:NEXT
2220 RETURN
```

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An M.D.'s bookkeeping system.

Doctor Your Records

Wilbur A. Muehlig, M.D.
726 N. 91 Plaza, #305
Omaha, NE 68114

When I was practicing medicine, my secretary kept a "daybook," entering each payment made by a patient, adding totals for the day, the month and, finally, the year.

When I left private practice, I continued the same general

method of keeping track of income checks, but my usual practice was to let the arithmetic go until the end of the year when my tax was due. At this time totaling my income was a rather discouraging job, but ideally suited to a computer.

This bookkeeping program should be of interest to anyone owning a few stocks and bonds. It was written with the retired person in mind, and therefore includes Social Security income, and annuity payments.

The program, which handles up to 35 entries a month, accepts eight types of entries: earned income, dividends, in-

terest, annuity funds, tax-free interest, Social Security, life insurance dividends, and miscellaneous items. The first four are taxable, the next three untaxable and the last is for your records only.

The program is written in Level II BASIC for a TRS-80 with 32K and a single disk drive. But it can be easily modified to use a cassette. The printer has a line length of 61 characters, but can be compressed to fit into 40 columns. Though the program can be used without a printer, much of its benefit is lost.

First Steps

Choose MAKE A FILE ENTRY (number three in Table 1) when first using the program. Enter the day, the month and the source of the income; choose the type of entry, the amount (Table 2), and press enter.

When you have finished making your entries, save them to disk using the first menu option and the disk option—SAVE MONTH'S FILE TO DISK (one in Table 1). Before adding more entries, load the previous ones with disk option two.

You can use menu options

WHAT DO YOU WANT TO DO?

- 1—DISK OPERATIONS
- 2—COMPUTATIONS
- 3—MAKE A FILE ENTRY
- 4—CORRECT AN ENTRY
- 5—DELETE AN ENTRY
- 6—SEE A PRINTOUT ON VIDEO
- 7—MAKE A HARD COPY
- 8—LEAVE THE PROGRAM

CHOOSE? 1

WHAT DO YOU WANT TO DO?

- 1—SAVE MONTH'S FILE TO DISK
- 2—LOAD MONTH'S FILE FROM DISK
- 3—SAVE YEARLY TOTALS TO DATE
- 4—LOAD YEARLY TOTALS
- 5—RETURN TO MENU

CHOOSE? 1

Table 1

1
TO END FILE ENTRIES, TYPE 99

DAY OF MONTH? 5

SOURCE OF INCOME (NOT OVER 24 SPACES)

? AT & T

WHAT TYPE OF ENTRY?

- | | |
|-----------------|---------------------------|
| 1—EARNED INCOME | 5—TAX FREE INTEREST |
| 2—DIVIDEND | 6—SOCIAL SECURITY |
| 3—INTEREST | 7—LIFE INSURANCE DIVIDEND |
| 4—ANNUITY | 8—MISCELLANEOUS ITEM |

CHOOSE? 2

AMOUNT OF DIVIDEND? 345.67

1 DATE 5 AT & T DIVIDEND \$ 345.67

IF THE ABOVE IS INCORRECT, TYPE 1. IF THE PART THEN DISPLAYED IS CORRECT, PRESS ENTER, OTHERWISE TYPE THE CORRECTION.

NOTE: IF THE ERROR IS IN THE TYPE OF INCOME, DELETE THE WHOLE ITEM AND REENTER.

IF THE ABOVE IS CORRECT, TYPE 2 TO GO ON?...

Table 2

Program Listing

```

1 REM * PERSONAL INCOME LEDGER PROGRAM *
2 REM * WILBUR A. MUEHLIG, M.D. *
3 REM * 726 N. 91 PLAZA, APT. 305,
4 REM * OMAHA, NE 68114
11 REM * OCT. 1979.
12 CLS
13 PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT
15 PRINTTAB(23)"INCOME LEDGER PROGRAM":PRINT:PRINT:PRINT
17
20 INPUT "DO YOU WANT INSTRUCTIONS FOR USE (Y/N)";Z$
30 IF Z$="Y" GOTO 4000
40 CLEAR 500:DEFDBL E,D,I,A,T,G,L,C,F,R,Q:DEFINT B,J,K,
H,X,Z,P:PI=1
45 DEFSTR S,M,V,Y,U
50 DIM S(35),E(25),DA(35),D(25),I(25),A(25),T(25),G(25),
L(35),C(25),F(35),R(35),M(12)
52 DATA JAN,FEB,MAR,APR,MAY,JUN,JUL,AUG,SEP,OCT,NOV,DEC

53 FOR H=1 TO 12:READ M$(H):NEXT
55 CLS:PRINT:PRINT:PRINT:PRINT
60 INPUT"YEAR OF THIS REPORT (####)";Y$
80 PRINT:INPUT"NUMBER OF THIS MONTH (1 TO 12)";H
100 CLS:PRINT
110 PRINT"WHAT DO YOU WANT TO DO?"

1-DISK OPERATIONS
2-COMPUTATIONS"
112 PRINT" 3-MAKE A FILE ENTRY
4-CORRECT AN ENTRY
5-DELETE AN ENTRY
6-SEE A PRINTOUT ON VIDEO"
113 PRINT" 7-MAKE A HARD COPY
8-LEAVE THE PROGRAM"
114 PRINT:INPUT"CHOOSE";J
120 ON J GOTO 200,1262,600,800,1000,1225,1400,1600
200 CLS:PRINT:PRINT:PRINT:PRINT:PRINT"WHAT DO YOU WANT
TO DO?"

1-SAVE MONTH'S FILE TO DISK
2-LOAD MONTH'S FILE FROM DISK
3-SAVE YEARLY TOTALS TO DATE"
210 PRINT" 4-LOAD YEARLY TOTALS
5-RETURN TO MENU"
220 PRINT:INPUT"CHOOSE";J
230 ON J GOTO 240,270,299,349,235
235 GOTO100
240 IF S(1)=" THEN PRINT"FILE EMPTY.":INPUT"PRESS ENTER";Z$:GOTO200
241 OPEN"O",1,M(H)
242 PRINT"SAVING MONTHLY FILE TO DISK...."
245 PRINT#1,P1
250 FOR X=1 TO P1-1
255 PRINT#1,S(X):PRINT#1,X;DA(X);E(X);D(X);I(X);A(X);T(X);G(X);F(X);C(X)
260 NEXT:CLOSE
265 PRINT:PRINT"MONTHLY FILE SAVED TO DISK":FOR Z=1 TO 500:NEXT:GOTO 100
270 ON ERROR GOTO 1800
272 OPEN"1",1,M(H)
275 INPUT#1,P1
280 FOR X=1 TO P1-1
285 INPUT#1,S(X):INPUT#1,X;DA(X);E(X);D(X);I(X);A(X);T(X);G(X);F(X);C(X)
287 PRINTX;S(X)
290 NEXT:CLOSE
291 FOR X=1 TO P1-1:L(X)=E(X)+D(X)+I(X)+A(X):R(X)=T(X)+G(X)+F(X)+C(X):NEXT
295 PRINT:PRINT"MONTHLY FILE LOADED.":INPUT" PRESS ENTER";Z$:GOTO 100
299 IF ES=0 AND DS=0 AND IS=0 AND AS=0 AND TS=0 AND GS=0 AND FS=0 AND CS=0 THEN INPUT"FILE EMPTY. PRESS ENTER.":Z$:GOTO200X
300 V$=M(H)+Y$:OPEN"O",2,V$
305 PRINT:PRINT"SAVING YEARLY TOTALS TO DISK..."
320 PRINT#2,ES;DS;IS;AS;TS;GS;FS:CLOSE
330 GOTO 100
349 ON ERROR GOTO 1800
350 V$=M(H-1)+Y$
355 OPEN"1",2,V$
360 PRINT:PRINT"LOADING YEARLY TOTALS...."
370 INPUT#2,ES,DS,IS,AS,TS,GS,FS:CLOSE
380 GOTO 100
599 REM * TO MAKE A FILE ENTRY *
600 CLS:PRINT:PRINT:PRINT
602 FOR X = P1 TO 50
610 CLS:PRINT:PRINT:PRINT
612 PRINTX
613 PRINT:PRINT"TO END FILE ENTRIES, TYPE 99"
615 PRINT:IF DA(X) <> 0 PRINT DA(X);" ";
620 INPUT"DAY OF MONTH";DA(X)
622 IF DA(X)=99 THEN P1=X:GOTO 100
630 IF S(X)<>"" PRINTS(X);" ";
640 PRINT:PRINT"SOURCE OF INCOME (NOT OVER 24 SPACES)":INPUT S(X)
645 IF LEN(S(X)) > 24 PRINT"TOO LONG. TRY AGAIN.":GOTO640
660 PRINT"WHAT TYPE OF ENTRY?
1-EARNED INCOME 5-TAX FREE INTEREST

```

```

2-DIVIDEND 6-SOCIAL SECURITY
3-INTEREST 7-LIFE INSURANCE DIVIDEND
4-ANNUITY 8-MISCELLANEOUS ITEM
662 ON ERROR GOTO 1700
665 PRINT:INPUT"CHOOSE";B
670 ON B GOTO 6100,6200,6300,6400,6500,6600,6700,6800
680 CLS:PRINT:PRINT
690 PRINT:PRINTX;" DATE";DA(X);" ";S(X)" ";
691 IF E(X)>0 PRINT"EARNED INCOME ";:PRINTUSING"$###,###.##";E(X)
692 IF D(X)>0 PRINT"DIVIDEND ";:PRINTUSING"$###,###.##";D(X)
693 IF I(X)>0 PRINT"INTEREST ";:PRINTUSING"$###,###.##";I(X)
694 IF A(X)>0 PRINT"ANNUITY ";:PRINTUSING"$###,###.##";A(X)
695 IF T(X)>0 PRINT"TAX FREE INTEREST ";:PRINTUSING"$###,###.##";T(X)
696 IF G(X)>0 PRINT"SOCIAL SECURITY ";:PRINTUSING"$###,###.##";G(X)
697 IF F(X)>0 PRINT"LIFE INS. DIV. ";:PRINTUSING"$###,###.##";F(X)
698 IF C(X)>0 PRINT"MISC. DEPOSIT ";:PRINTUSING"$###,###.##";C(X)

700 PRINT:PRINT"IF THE ABOVE IS INCORRECT, TYPE 1. IF THE PART THEN DISPLAYED"
705 PRINT"IS CORRECT, PRESS ENTER, OTHERWISE TYPE THE CORRECTION."
707 PRINT:PRINT"NOTE: IF THE ERROR IS IN THE TYPE OF INCOME, DELETE THE WHOLE"
708 PRINT"ITEM AND REENTER."
709 REM * INCOME TYPE ERROR CAN CAUSE CONFUSION IF NOT DELETED *
710 PRINT:INPUT"IF THE ABOVE IS CORRECT, TYPE 2 TO GO ON";Z
720 IF Z=1 GOTO 610
730 IF Z<>2 GOTO 710
740 NEXT:GOTO100
799 REM * USES SAME CORRECTION SECTION AS FILE ENTRY *
800 CLS:PRINT:PRINT:PRINT
810 PRINT"WHICH NUMBER DO YOU WISH TO CORRECT"
815 PRINT:PRINT" (0 TO RETURN TO MENU)"
":INPUT K
817 IF K=0 GOTO 100
820 FOR X=1 TO P1-1
830 IFK=X GOTO 680
840 NEXT
850 GOTO 100
999 REM * DELETES ENTRY AND RENUMBERS *
1000 PRINT"WHICH NUMBER DO YOU WANT TO DELETE?"
1002 PRINT" (0 TO RETURN TO MENU)"
":INP
UT X
1005 IF X=0 GOTO100
1010 DA(X)=S(X):E(X)=D(X):I(X)=A(X):T(X)=G(X):F(X)=C(X):L(X)=R(X):R(X)=0
1020 FOR X=X+1 TO P1:DA(X-1)=DA(X):S(X-1)=S(X):E(X-1)=E(X):D(X-1)=D(X):I(X-1)=I(X):A(X-1)=A(X):T(X-1)=T(X):G(X-1)=G(X):F(X-1)=F(X):C(X-1)=C(X):L(X-1)=L(X):R(X-1)=R(X)
1025 NEXT
1030 P1=P1-1
1040 PRINT:PRINT"ENTRY DELETED.":FOR Z=1 TO 700:NEXT:GOTO 100
1200 CLS:PRINTTAB(16)"INCOME LEDGER FOR ";M(H);" ";Y$:PRINT
1210 PRINT"## DAY SOURCE OF INCOME TAXABLE
NONTAX."
1220 PRINT STRING$(54,45):RETURN
1225 GOSUB 1200 REM * ALLOWS REPRINTING OF HEADING ON EACH
PAGE OF VIDEO *
1230 FOR X = 1 TO P1-1
1235 IF X/11=INT(X/11) PRINT:INPUT"PRESS ENTER TO CONTINUE";Z$:CLS:PRINT:GOSUB 1200
1240 IF R(X)=0 PRINT USING"## ## %
$###,###.##";X;DA(X);S(X);L(X)
1250 IF L(X)=0 PRINT USING"## ## %
$###,###.##";X;DA(X);S(X);R(X)
1260 NEXT:PRINT:INPUT"ENTER 1 TO RETURN TO MENU, 2 TO SEE YEARLY TOTALS.":Z:IF Z=1 GOTO 100 ELSE 1279
1262 CLS:PRINT:PRINT:PRINT"THE FOLLOWING COMPUTES INCOME TOTALS FOR THE MONTH AND FOR"
1263 PRINT"THE YEAR. THE MONTH'S ENTRIES SHOULD BE COMPLETE, YOUR PRINTER"
1264 PRINT"READY, AND THE YEARLY TOTALS INPUT FROM DISK BEFORE CONTINUING."
1265 PRINT:PRINT"TO RETURN TO MENU, TYPE 1, TO CONTINUE WITH THE COMPUTATION."
1266 PRINT"TYPE 2.":PRINT:INPUT Z
1267 IF Z=1 GOTO 100
1268 IF Z<>2 GOTO 1262
1270 GOSUB 7000
1279 CLS
1280 PRINT" TOTALS FOR ";M(H);" ";Y$;" MONTH
YEAR TO DATE"
1282 PRINT
1285 PRINT"TOTAL EARNED INCOME ";:PRINTUSING"$###,###.## $####,###.##";ET,ES

```

Program continues

```

1290 PRINT"TOTAL DIVIDENDS" ";;PRINTUSING"$$$$
1300 PRINT"TOTAL INTEREST" ";;PRINTUSING"$$$$
1310 PRINT"TOTAL ANNUITY FUNDS" ";;PRINTUSING"$$$$
1320 PRINT"TOTAL TAX FREE INTEREST" ";;PRINTUSING"$$$$
1330 PRINT"SOCIAL SECURITY" ";;PRINTUSING"$$$$
1340 PRINT"TOTAL LIFE INS. DIV." ";;PRINTUSING"$$$$
1355 PRINT:US="$$$$$,000.00"
1360 PRINT"TOTAL TAXABLE INCOME TO DATE" ";;PRIN
TUSING$;LS
1370 PRINT"TOTAL NONTAX. INCOME TO DATE" ";;PRIN
TUSING$;RS
1380 PRINT"TOTAL INCOME TO DATE" ";;PRIN
TUSING$;Q
1390 PRINT:INPUT"PRESS ENTER TO CONTINUE";Z$;GOTO 100
1400 CLS:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT"IF YOUR PR
INTER ISN'T READY, ENTER 1 TO RETURN TO MENU,"
1402 PRINT:INPUT" OTHERWISE ENTER 2.";Z:IF Z=1
GOTO 100
1405 CLS:LPRINTTAB(32)"INCOME LEDGER FOR ";M(H);" ";;YS:
LPRINT""
1410 LPRINTTAB(19)"** DAY SOURCE OF INCOME
TAXABLE NONTAX."
1420 LPRINTTAB(19) STRING$(54,45)
1430 FOR X=1 TO P1-1
1440 IF R(X)=0 LPRINTTAB(19) USING"00 00 %
% $000,000.00";X;DA(X);S(X);L(X)
1450 IF L(X)=0 LPRINTTAB(19) USING"00 00 %
% $000,000.00";X;DA(X);S(X);R(X)
1460 NEXT:LPRINTTAB(19) STRING$(54,45):LPRINT""
1480 LPRINTTAB(19)" TOTALS FOR ";M(H);" ";;YS;"
MONTH
YEAR TO DATE"
1482 LPRINT""
1485 LPRINTTAB(19)"TOTAL EARNED INCOME" ";;LPRINT
TAB(19)USING"$0000,000.00 $0000,000.00";ET,ES
1490 LPRINTTAB(19)"TOTAL DIVIDENDS" ";;LPRINT
TAB(19)USING"$0000,000.00 $0000,000.00";DT,DS
1500 LPRINTTAB(19)"TOTAL INTEREST" ";;LPRINT
TAB(19)USING"$0000,000.00 $0000,000.00";IT,IS
1510 LPRINTTAB(19)"TOTAL ANNUITY FUNDS" ";;LPRINT
TAB(19)USING"$0000,000.00 $0000,000.00";AT,AS
1520 LPRINTTAB(19)"TOTAL TAX FREE INTEREST" ";;LPRINT
TAB(19)USING"$0000,000.00 $0000,000.00";TT,TS
1530 LPRINTTAB(19)"SOCIAL SECURITY" ";;LPRINT
TAB(19)USING"$0000,000.00 $0000,000.00";GT,GS
1540 LPRINTTAB(19)"TOTAL LIFE INS. DIV." ";;LPRINT
TAB(19)USING"$0000,000.00 $0000,000.00";FT,FS
1555 US="$0000,000.00"
1557 LPRINT""
1560 LPRINTTAB(19)"TOTAL TAXABLE INCOME TO DATE"
";;LPRINTTAB(19)USING$;LS
1570 LPRINTTAB(19)"TOTAL NONTAX. INCOME TO DATE"
";;LPRINTTAB(19)USING$;RS
1580 LPRINTTAB(19)"TOTAL INCOME TO DATE"
";;LPRINTTAB(19)USING$;Q
1590 PRINT:INPUT"PRESS ENTER TO CONTINUE";Z$;GOTO100
1600 CLS:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:INPU
T"HAVE YOU SAVED FILES TO DISK (Y/N)";Z$
1610 IF Z$="N" GOTO 100
1620 PRINT:PRINT"OK. SO LONG!";END
1700 PRINT:INPUT"ENTRY ERROR. PRESS ENTER AND TRY AGAI
N.";Z$;GOTO 665
1800 PRINT:INPUT"NO FILE ON DISK. PRESS ENTER.";Z$;GOT
O100
4000 CLS:PRINT:PRINT
4010 PRINT" PERSONAL INCOME LEDGER";P
RINT
4020 PRINT"1) DISK FILES ARE NAMED AUTOMATICALLY. THE
MONTHLY FILES ARE"
4030 PRINT"JAN, FEB, ETC. THE YEARLY TOTAL FILES ARE J
AN1979, FEB1979,"
4040 PRINT"ETC., AND ACCUMULATE THE FIGURES FOR THE YEA
R TO DATE."
4060 PRINT
4090 PRINT"2) MAKE ENTRIES FOR THE MONTH. SAVE TO DISK
WITH DISK OPTION"
4100 PRINT"3) BEFORE ADDING ENTRIES FOR THE SAME MONT
H, USE DISK OPTION"
4110 PRINT"4) TO LOAD THE PREVIOUS ENTRIES."
4130 PRINT:INPUT"PRESS ENTER";Z$;CLS:PRINT:PRINT:PRINT
4140 PRINT"3) UNDER TYPES OF INCOME, THE FIRST FOUR ARE
TAXABLE, THE LAST"
4150 PRINT"FOUR NONTAXABLE AND ARE SO RECORDED BY THE P
ROGRAM."
4160 PRINT"MISCELLANEOUS TYPES SHOULD INCLUDE SUCH THIN
GS AS LOAN"
4170 PRINT"REPAYMENTS, GIFTS, REFUNDS, ETC. MISCELLANE
OUS ITEMS ARE NOT"
4180 PRINT"TOTALLED INTO NONTAXABLE INCOME SINCE THEY DO
N'T REPRESENT"
4190 PRINT"INCOME.";PRINT
4200 PRINT"4) MENU CHOICES 4, 5 AND 6 MAY BE USED DURIN
G PREPARATION OF"
4210 PRINT"MONTHLY FILES."
4220 PRINT:INPUT"PRESS ENTER";Z$;CLS
4230 PRINT:PRINT"5) WHEN A MONTHLY FILE IS COMPLETE, U
SE DISK OPTION"

```

four (CORRECT AN ENTRY), five (DELETE AN ENTRY), or six (SEE A PRINTOUT ON VIDEO) at any time while making these entries. Option four is also useful for checking the income type you have chosen, since it is not printed by either the video or hard copy printouts.

After the month's entries are on disk, disk option four loads the yearly totals from the previous month. Menu option two totals each type of income for the month and the year and displays the results. You can use disk option three to save the totals, menu option six for a complete video printout, and seven for hard copy (see Table 3 for sample).

Changes

Change to cassette data files

will require alterations between lines 240 and 370. Sequential disk files, which are used, are quite similar to cassette files, and use of the Level II Basic Reference Manual should make this change simple.

Taxable items can be changed to nontaxable or vice versa in lines 7000-7070 and 6099-6820. Note that L() and R() collect the taxable and nontaxable items for printing in columns. Refer to the list of variables (Table 4) as necessary.

Miscellaneous entries include loan repayments, refunds, and money from the sale of stocks and bonds. The program doesn't handle capital gains because of their special requirements, but you can type the data on the back of the monthly pages.

```

4240 PRINT"1 TO SAVE IT TO DISK. NEXT, GET YOUR PRINT
ER READY. IF THIS"
4245 PRINT"RESULTS IN LOSS OF THE PROGRAM AND/OR MONTHL
Y FILE, RELOAD"
4250 PRINT"THEN. THEN USE DISK OPTION #4 TO LOAD THE Y
EARLY TOTAL FILE"
4255 PRINT"AND MENU OPTION #2 FOR COMPUTATIONS. AT THI
S TIME, THE RESULTS"
4260 PRINT"MAY BE CHECKED ON VIDEO (MENU OPTION #6) OR
HARD COPY MADE"
4270 PRINT"(OPTION #7). THE YEARLY TOTAL SHOULD BE SAV
ED TO DISK BEFORE"
4280 PRINT"LEAVING THE PROGRAM."
4290 PRINT
4310 PRINT"6) IT IS DESIRABLE TO KEEP A SET OF FILES ON
A SECOND DISK"
4320 PRINT"FOR BACKUP."
4330 PRINT:PRINT"7) REENTRY TO THE PROGRAM, IF NEEDED,
IS AT LINE 100."
4340 PRINT:INPUT"PRESS ENTER";Z$;CLS:GOTO 40
6000 END
6099 REM * CLASSIFY INCOME AND SEPARATE INTO TAXABLE, L
(X),
AND NONTAXABLE, R(X) *
6100 IF E(X)<>0 PRINT E(X);
6110 PRINT:INPUT"AMOUNT OF EARNED INCOME";E(X)
6120 L(X) = E(X):GOTO 600
6200 IF D(X)<>0 PRINT D(X);
6210 PRINT:INPUT"AMOUNT OF DIVIDEND";D(X)
6220 L(X) = D(X):GOTO 600
6300 IF I(X)<>0 PRINT I(X);
6310 PRINT:INPUT"AMOUNT OF INTEREST";I(X)
6320 L(X) = I(X):GOTO 600
6400 IF A(X)<>0 PRINT A(X);
6410 PRINT:INPUT"AMOUNT OF ANNUITY";A(X)
6420 L(X)=A(X):GOTO 600
6500 IF T(X)<>0 PRINT T(X);
6510 PRINT:INPUT"AMOUNT OF TAX FREE INTEREST";T(X)
6520 R(X)=T(X):GOTO 600
6600 IF G(X)<>0 PRINT G(X);
6610 PRINT:INPUT"AMOUNT OF SOCIAL SECURITY";G(X)
6620 R(X)=G(X):GOTO 600
6700 IF F(X)<>0 PRINT F(X);
6710 PRINT:INPUT"AMOUNT OF LIFE INSURENCE DIVIDEND";F(X)
)
6720 R(X)=F(X):GOTO 600
6800 IF C(X)<>0 PRINTC(X);
6810 PRINT:INPUT"AMOUNT OF MISCELLANEOUS ITEM";C(X)
6820 R(X)=C(X):GOTO 600
7000 REM * COMPUTATIONS *
7005 FOR X=1 TO P1-1
7010 ET=ET+E(X):DT=DT+D(X):IT=IT+I(X):AT=AT+A(X)
7020 TT=TT+T(X):GT=GT+G(X):FT=FT+F(X)
7025 NEXT
7030 ES=ES+ET:DS=DS+DT:IS=IS+IT:AS=AS+AT
7040 TS=TS+TT:GS=GS+GT:FS=FS+FT
7050 LS=ES+DS+IS+AS
7060 RS=TS+GS+FS
7070 Q=LS+RS
7075 RETURN

```

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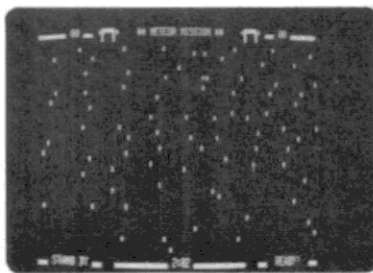
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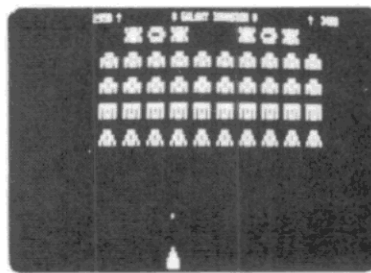
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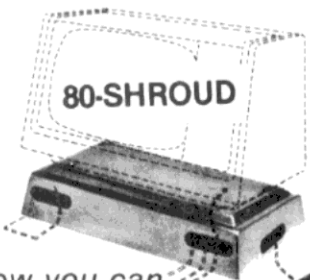
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This program considers life insurance dividends as nontaxable income, although they are actually premium refunds. You can change this by omitting "+ FS" from line 7060.

Annuity payments can also be modified to record a second earned income by changing the entry name in lines 660, 694, 1310, 1510 and 6410.

The printout is for five and one-half by eight and one-half-inch paper at 12 characters per inch. The printout itself is 54 characters wide with a seven-character margin.

You can narrow the printout by as much as 14 characters by reducing the Source of Income heading from 24 to 10 and removing the same number of spaces from between the percentage signs in lines 1440 and 1450. Abbreviate other terms such as Total Earned Income (line 1485), and decrease the first number in STRING\$(54,45) (lines 1420 and 1460).

To use a 40 column printer, get rid of the margin by removing TAB(7) after each LPRINT.

If you decrease the hard copy width and want your video printout to match, make the same

changes in lines 1200 to 1390.

About the Program

The program asks for the year and month and automatically generates data files. In any month but January, the yearly total file will be from the preceding month.

The program will allow you to return to the menu if you choose a wrong number. If you press the break key and get into BASIC, type GOTO 100 to get back to the menu without losing data files.

Line 240 saves the original file if you accidentally choose SAVE MONTH'S FILE TO DISK instead of LOAD MONTH'S FILE FROM DISK. Without some such safeguard the program could file a string of zeros and erase the original file. Line 299 gives a similar safeguard for SAVE YEARLY TOTALS TO DATE.

An ON ERROR GOTO prevents data loss if you choose LOAD MONTH'S FILE FROM DISK when there is no such file or pick LOAD YEARLY TOTALS.

Using TRSDOS 2.2 or 2.3 instead of NEWDOS and without the ON ERROR protection, the above causes the program to be

Y\$	Year
V\$	Yearly file name
M()	String, name of month
H	Number of month
DA()	Day of month
S()	String, source of income
E(),ET,ES	Earned income, monthly total, yearly total
D(),DT,DS	Dividends, monthly total, yearly total
I(),IT,IS	Interest
A(),AT,AS	Annuity
T(),TT,TS	Tax free interest
G(),GT,GS	Social Security
F(),FT,FS	Life insurance dividend
C()	Miscellaneous items
L()	All taxable items
LS	Total taxable income to date
R()	All nontaxable items
RS	Total nontaxable income to date
Q	Total income to date
U\$	Formatter
X	File counter
B,J,K,Z	Counters and null
P1	Number of items plus one (99 to end entries)

Table 4. Variables for Ledger Program

booted out to BASIC rather than to DOS. If that should happen, the files can easily be saved by typing GOTO 100. The protection, however, works the same with TRSDOS as with NEWDOS.

In regard to disk space, none of my summary data has taken

up more than one gran. Since the program requires nine gran, the total disk space, including the program, for a year comes to 32 gran and fits nicely onto one disk. Using hard copy, the same disk can be used year after year. ■

##	DAY	SOURCE OF INCOME	TAXABLE	NONTAX.
1	1	TIAA	\$ 225.68	
2	1	IA PS	\$ 153.00	
3	3	NW PS	\$ 212.50	
4	3	SS (PD TO BANK)		\$ 418.10
5	3	MASS MUT DIV		\$ 33.15
6	5	GAS SERV	\$ 160.00	
7	10	NE INV TRUST	\$ 178.52	
8	10	TEXACO	\$ 50.00	
9	15	OMAHO NAT'L CORP	\$ 225.00	
10	15	MUNI INV TRUST		\$ 58.10
11	15	TESORO	\$ 108.00	
12	17	CORP INC FUND	\$ 35.05	
13	21	KC P & L	\$ 256.00	
14	29	JAPAN FUND	\$ 15.00	
TOTALS FOR MAR 1979				
			MONTH	YEAR TO DATE
TOTAL EARNED INCOME			\$ 0.00	\$ 0.00
TOTAL DIVIDENDS			\$ 1,393.07	\$ 1,740.12
TOTAL INTEREST			\$ 0.00	\$ 0.00
TOTAL ANNUITY FUNDS			\$ 225.68	\$ 677.04
TOTAL TAX FREE INTEREST			\$ 58.10	\$ 495.10
SOCIAL SECURITY			\$ 418.10	\$ 1,254.30
TOTAL LIFE INS. DIV.			\$ 33.15	\$ 99.67
TOTAL TAXABLE INCOME TO DATE			\$ 2,417.16	
TOTAL NONTAX. INCOME TO DATE			\$ 1,849.07	
TOTAL INCOME TO DATE			\$ 4,266.23	

Table 3. Income Ledger for Mar 1979

Table 3. Income Ledger for Mar 1979

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The Zero Flag

Consider Listing 1, loaded using T-BUG.

The C2 instruction in memory location is a JPNZ,NN which signals the computer that if the comparison of the contents of the D and A registers is not zero that it should go back to the location specified by the NN which in our case is 4A02. This is the location of the decrement instruction.

If you've ventured into the world of assembly programming you'll eventually need a delay or timing loop. Though there is no "best way" to delay a program, we can explore various methods.

Basically a time delay loads a value into a register (or values into a pair of registers) and then decrements this value to zero. This means we also need a mechanism that tells the computer when it has decremented the initial value to zero, so that it can continue the program.

One thing that this routine does not take into account is that when decrementing a single register, the zero flag is operative. (This is not true when we come to the case of decrementing a pair of registers.)

You notice that to continue the decrementing process, we had to tell the program to go back to a specific location. This means that if you did not load the program into the memory locations specified, you would have had to change the return

FF	-1
FE	-2
FD	-3
FC	-4
FB	-5
FA	-6
F9	-7
F8	-8
F7	-9
F6	-10
F5	-11
F4	-12
F3	-13
F2	-14
F1	-15
F0	-16

Table 1.
Minus Relative Jump Values
(twos complement form)

locations in 4A07 and 4A08.

In Listing 2 we will use a relative jump instruction that obviates the need for such changes. This allows the program to relocate, for with the relative jump, the computer knows where it should go even if you change the origin of the routine.

In this listing I've introduced the mnemonic form of the instruction.

This listing is considerably shorter than the first one for

several reasons. One is that the first example is used to illustrate the idea of comparing the contents of one register with another to determine when the zero condition is reached. The first listing tells the program where to go if the zero condition has not been reached. This takes three locations, while the new method uses but two locations in memory.

The jump relative instruction in location 4A03 works in conjunction with the FD information in location 4A04. We know that to make the loop decrement we have to keep returning to location 4A02. Location 4A02 is three steps back from location 4A04, counting location 4A04 as step one. You have signaled the computer that this is what you want by inserting FD.

What is the significance of FD? It is a minus three in twos complement form. If you had needed a relative jump of minus seven, then the FD would have become F9. Table 1 shows the relative jump values from minus one to minus 16.

The absolute delays produced by the simple timing loop using a single register is just about maximum when the register initial value is FF (255 decimal). I say "just about" because if the initial value in the register is 00, then you have 256 iterations of the loop, because the first decrement takes you from 00 to FF.

This is a bone for the nit-pickers in the group.

4A00	16	Load register D with N (value to decrement)
4A01	FF	Hex for 255
4A02	15	Decrement value in D register
4A03	3E	Load the A register with zero... this is
4A04	00	the test value to show loop is done
4A05	BA	Compare value in D with value in A
4A06	C2	If this test shows A and D both zero the
4A07	02	loop is finished. If not pgm goes to 4A02
4A08	4A	and continues decrementing value in D
4A09	C3	When decrement is finished the program
4A0A	80	returns to T-BUG which is at 4380.
4A0B	43	

Listing 1.

4A00	16	LD D,N
4A01	FF	
4A02	15	DEC D
4A03	20	JRNZ
4A04	FD	
4A05	C3	
4A06	80	
4A07	43	

Listing 2.

Longer Delays

If we need longer delays, we can insert another identical loop after the first one, but there is another route to travel. This method decrements a pair of registers. If one register can be packed with FF, then two registers can be packed with FFFF.

Remember, if we use a pair of registers we will have to resort to some sort of a compare operation as with Listing 1, because when you decrement a pair of registers, the zero flag is not automatically working in your behalf. Thus we need some program steps to get the zero flag back from vacation.

Since the idea of the jump relative code seems to have merit we will go that route as well. When possible, I like to use the BC register pair for decrementing. BC seems to shout out "byte counter" and is, for me, a memory jogger.

Running Listing 3, you notice that it takes more time before the program returns to T-BUG.

```

4A00      01      LD BC,NN
4A01      FF
4A02      FF
4A03      0B      DEC BC
4A04      78      LD A,B
4A05      B0      OR B
4A06      B1      OR C
4A07      20      JRNZ
4A08      FA
4A09      C3
4A0A      80
4A0B      43
  
```

Listing 3. Decrementing the BC register pair.

This tells us that we have achieved a much longer delay than when decrementing the contents of a single register. The delay is in the neighborhood of 1.1 seconds.

The listing also uses the OR function, which is why we had to do what we did in memory location 4A04.

To operate any of the logic functions, you have to call on the services of the A register.

The jump relative figure in location 4A08 is equal to minus six (see Table 1), the proper

value to get back to location 4A03, which contains the DEC BC instruction.

The above is but one viable routine, not the only one.

The Interrupt

Now let us get down to the business of combining a single register decrement and the register pair decrement to achieve significantly longer time delays. The game plan is to interrupt the decrement of the register pair while a single register decrements to zero. BC is the register pair in Listing 4 and the D register is used as the interrupt register.

When you load Listing 4 and RUN, be prepared to sit back for two minutes and 32 seconds before it returns you to T-BUG. The key element of the time delay is the value in location 4A05, the value being decremented in the D register.

If you change this value from FF to AA, then the delay time becomes one minute and 43 seconds. If it is changed to 64,

then the time delay is one minute and one second. Changing this value to OA is going to give you a total time delay of about eight seconds. Thus this delay routine is quite flexible and should satisfy all but the most unusual needs.

You will get the most good out of this exercise if you use the Breakpoint of T-BUG to examine the program at various points. ■

```

4A00      01      LD BC,NN
4A01      FF
4A02      FF
4A03      0B      DEC BC
4A04      16      LD D,N
4A05      FF
4A06      15      DEC D
4A07      20      JRNZ
4A08      FD
4A09      78      LD A,B
4A0A      B0      OR B
4A0B      B1      OR C
4A0C      20      JRNZ
4A0D      F5
4A0E      C3
4A0F      80
4A10      43
  
```

Listing 4.



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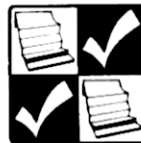


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key can be pressed to read the current width to length ratio from the screen.

If preferences for this ratio were randomly distributed, there wouldn't be much point to this experiment. The interesting and remarkable fact is that most people prefer the same width to length ratio. This preference falls into a fairly narrow range centered at 0.618.

Studies as far back as 1876 by G. T. Fechner in Germany confirm this attraction. He found a definite preference at 0.62 and most results in the range 0.57 to 0.67.

An aesthetic preference for 0.618 (actually $2/(1+\sqrt{5})$) was known even before the time of Pythagoras. Its reciprocal is of fundamental importance.

Called the golden ratio or divine proportion, it appears in many and diverse ways throughout mathematics, nature, art and architecture. This golden ratio is an irrational number 1.61803398 and is often expressed algebraically as $a:b = b:(a+b)$. The number is also known as Φ , taken from the first letter of the name of Phidias, the Greek sculptor and planner under Pericles, who utilized the golden ratio in his work.

Have you ever wondered about the size and shape of things, why paintings, books and cards have the dimensions they do?

The programs included with this article are designed to help

```

0 REM PROGRAM TO DRAW SUCESSIVELY SMALLER RECTANGLES
1 REM BY DAVID R. CECIL
2 REM A SQUARE IS FORMED FIRST
3 REM IF THE SCALE FACTOR IS ONE THEN THE SQUARE
4 REM IS APPROX. 14.4 CM. PER SIDE
10 INPUT " SCALE FACTOR BETWEEN 0 AND 1";N
20 INPUT " T (FOR TOP) OR L (FOR LEFT)";V$:CLS
21 REM T DENOTES THAT THE TOP IS APPROACHING THE BOTTOM
22 REM (THE HORIZONTAL DIM. IS DECREASING), WHILE
23 REM L DENOTES THE LEFT APPROACHING THE RIGHT (THE
24 REM VERTICAL DIM. IS DECREASING)
30 X1=20+90*N:Y1=41-40*N
35 REM FORM THE TOP LINE FROM (20,Y1) TO (X1,Y1)
40 FOR X=20 TO X1
50 SET(X,Y1):NEXT X
55 REM FORM THE RIGHT SIDE FROM (X1,Y1) TO (X1,40)
60 FOR Y=Y1 TO 40
70 SET(X1,Y):NEXT Y
75 REM FORM THE BOTTOM FROM (X1,40) TO (20,40)
80 FOR X=X1 TO 20 STEP -1
90 SET(X,40):NEXT X
95 REM FORM THE LEFT SIDE FROM (20,40) TO (20,Y1)
100 FOR Y=40 TO Y1 STEP -1
110 SET(20,Y):NEXT Y
120 GOSUB 300
125 REM LINES 140 TO 210 RE USED FOR CHANGING THE TOP,
126 REM WHILE LINES 220 TO 290 ARE FOR CHANGING THE LEF
    T SIDE
130 IF V$="L" THEN 220
135 REM ERASE TOP LINE
140 FOR Y=Y1 TO 40
150 FOR X=20 TO X1
160 RESET(X,Y):NEXT X
165 REM FORM NEW TOP LINE 1 LINE BELOW OLD TOP LINE
170 FOR X=20 TO X1
180 SET(X,Y+1):NEXT X
190 GOSUB 300
200 NEXT Y
210 END
215 REM ERASE LEFT LINE
220 FOR X=20 TO X1
230 FOR Y=Y1 TO 41
240 RESET(X,Y):NEXT Y
245 REM FORM NEW LEFT LINE 1 LINE TO RIGHT OF OLD LEFT
    LINE
250 FOR Y=Y1 TO 40
260 SET(X+1,Y):NEXT Y
270 GOSUB 300
280 NEXT X
290 END
291 REM SUBROUTINE 300 PRODUCES A PAUSE AND ALLOWS YOU
292 REM TO READ, BY PRESSING ANY KEY, THE RATIO OF
293 REM SHORTER SIDE TO LONGER SIDE
300 FOR Z=1 TO 300
310 IF INKEY$="" THEN 340
320 IF V$="L" THEN PRINT#950,(X1-X)/(90*N);:GOTO 340
330 PRINT#950,(40-Y)/(40*N);
340 NEXT Z
350 RETURN

```

Program Listing 1. The Square

The Divine Proportion by H. E. Huntley and *The Geometry of Art and Life* by M. Ghyka have numerous examples of the occurrence of the golden ratio; such as multiple reflections of light, arrangement of leaves on plants, the musical chromatic scale, the great pyramid, the human figure, dynamic symmetry, and on and on. (Both books are published by Dover Books.)

Take a look at the computer programs. The first one generates a square of any desired size. Then, having asked wheth-

er to shorten the vertical or the horizontal dimension, it proceeds to do so.

Note that the ratios given on the screen are approximations. Pixels are not square and scale factors are used in evaluating each ratio. If the lengths of lines are measured directly on the video screen, the ratios obtained may differ slightly from those of the program.

The second program generates nine ellipses, pausing after each one. The major axis stays constant and may be designated horizontal or vertical. Use

the break key to terminate this program.

Most people prefer an ellipse with a minor to major ratio in the range .57 to .67. The 5.4 value used in line 90 can be changed to something a bit smaller (such as 5.1) to shorten the horizontal width. If it is made higher (such as 5.6), the horizontal dimension is lengthened. Keep this in mind if you find that the ratios are not quite true in the video representation.

Changing the 90 in step 60 to a smaller value will display fewer points (try 45), while more points will be displayed for values larger than 90 (such as 180). The program will only display one ellipse at a time, if 60 is changed to 50 in line 170.

To generate other ellipses, change line 190. Be sure all data values are less than 10 so that the ellipse does not exceed the size of the video screen.

The Parallelepiped

The last program generates a

box (rectangular parallelepiped) with square front and back. The top is gradually lowered. Ratios of vertical to horizontal and slant (depth) to the vertical dimension are given.

Fig. 1 should be used in conjunction with Program Listing 3. The numbers in the program's REM statements refer to lines of the box represented in the figure.

Preferences for box sizes are not nearly as pronounced as for the rectangle, but four of the more interesting box dimensions are:

- $1, \Phi, \Phi$ —used for the Golden Chamber containing the tomb of Ramesses IV.

- $1, 1, \Phi$ —found for the volume of a stool of Tutankhamen's tomb.

- $1, \Phi, \Phi^2$ —called the "Golden Solid" and often used for Egyptian tombs.

- $1, \Phi^2, \Phi^3$ —found to be the volume in many pieces of furniture of the Queen Anne and Chippendale styles. ■

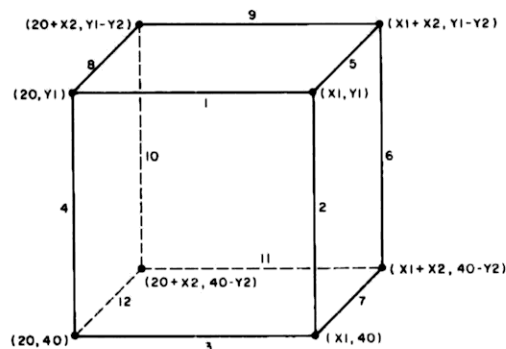


Fig. 1

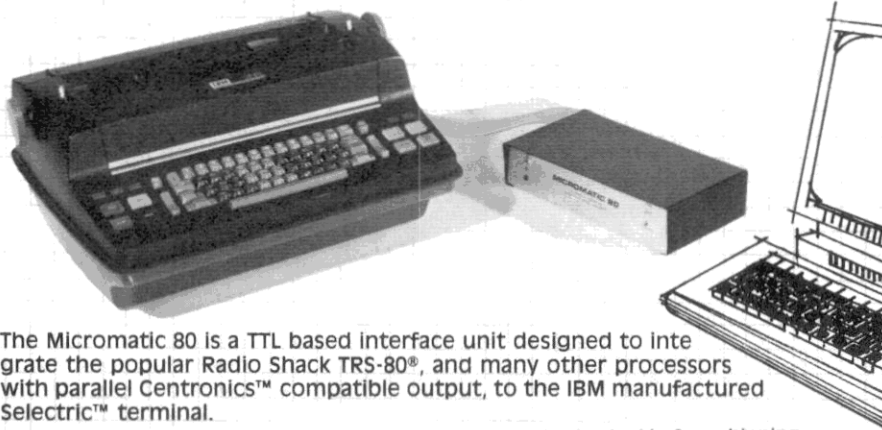
```
10 INPUT"ENTER SCALE FACTOR BETWEEN 0 AND .865";N
20 X1=20+90*N:X2=(X1-20)/3
30 Y1=41-40*N:Y2=(40-Y1)*(4/21):CLS
35 REM DRAW FRONT TOP LINE 1
40 FOR X=20 TO X1
50 SET(X,Y1):NEXT X
55 REM DRAW FRONT RIGHT SIDE 2
60 FOR Y=Y1 TO 40
70 SET(X1,Y):NEXT Y
75 REM DRAW FRONT BOTTOM LINE 3
80 FOR X=X1 TO 20 STEP -1
90 SET(X,40):NEXT X
95 REM DRAW FRONT LEFT SIDE 4
100 FOR Y=40 TO Y1 STEP -1
110 SET(20,Y):NEXT Y
115 REM DRAW RIGHT TOP LINE 5
120 FOR X=X1 TO X1+X2
130 SET(X,Y1-(Y2/X2)*(X-X1)):NEXT X
135 REM DRAW RIGHT BACK VERTICAL LINE 6
140 FOR Y=Y1-Y2 TO 40-Y2
150 SET(X1+X2,Y):NEXT Y
155 REM DRAW RIGHT BOTTOM LINE 7
160 FOR X=X1+X2 TO X1 STEP -1
170 SET(X,40-(Y2/X2)*(X-X1)):NEXT X
175 REM DRAW LEFT TOP LINE 8
180 FOR X=20 TO 20+X2
190 SET(X,Y1-(Y2/X2)*(X-20)):NEXT X
195 REM DRAW BACK TOP LINE 9
200 FOR X=20+X2 TO X1+X2
210 SET(X,Y1-Y2):NEXT X
215 REM DRAW LEFT BACK VERTICAL LINE 10
220 FOR Y=Y1-Y2 TO 40-Y2 STEP 2
230 SET(20+X2,Y):NEXT Y
235 REM DRAW BACK BOTTOM LINE 11
240 FOR X=20+X2 TO X1+X2 STEP 2
250 SET(X,40-Y2):NEXT X
255 REM DRAW LEFT BOTTOM LINE 12
260 FOR X=20 TO 20+X2 STEP 2
270 SET(X,40-(Y2/X2)*(X-20)):NEXT X
272 FOR Z=1 TO 300:NEXT Z
275 REM LOWER THE FRONT TOP LINE 1
280 FOR X=20 TO X1
290 RESET(X,Y1):SET(X,Y1+1):NEXT X
295 REM LOWER RIGHT TOP LINE 5
300 FOR X=X1 TO X1+X2
310 RESET(X,Y1-(Y2/X2)*(X-X1))
320 SET(X,1+Y1-(Y2/X2)*(X-X1)):NEXT X
325 REM LOWER BACK TOP LINE 9
330 FOR X=X1+X2 TO 20+X2 STEP -1
340 RESET(X,Y1-Y2):SET(X,Y1-Y2+1):NEXT X
345 REM LOWER LEFT TOP LINE 8
350 FOR X=20+X2 TO 20 STEP -1
360 RESET(X,Y1-(Y2/X2)*(X-20))
370 SET(X,1+Y1-(Y2/X2)*(X-20)):NEXT X
375 REM REDRAW TOP PART OF LEFT BACK VERTICAL LINE 10
380 FOR Y=Y1 TO Y1-Y2+2 STEP -1
390 RESET(20+X2,Y):NEXT Y
400 FOR Y=Y1 TO Y1-Y2+1 STEP -2
410 SET(20+X2,Y):NEXT Y
415 REM ROUTINE TO PRINT RATIOS IF DESIRED
420 FOR Z=1 TO 300
430 IF INKEY$="" THEN 450
440 PRINT#950,(40-Y1)/(40*N);SQR(X2[2+Y2[2]/(40-Y1)/1.9
5;
450 NEXT Z
460 Y1=Y1+1
470 IF Y1<40-Y2 THEN 280 ELSE STOP
```

Program Listing 2. The Ellipse

```
0 ON ERROR GOTO 200
10 PRINT"CHOOSE SCALE FACTOR BETWEEN 0 AND 1":INPUT N
20 W=10*N:A=W:B=W
30 PI=3.14159:WW=10
40 PRINT"INPUT H FOR CONSTANT LENGTH MAJOR AXIS TO BE H
ORIZONTAL,V FOR CONSTANT LENGTH VERTICAL MAJOR AXI
S":INPUT D$
50 CLS
60 FOR I=0 TO 2*PI STEP 2*PI/90
70 IF D$="V" THEN A=W ELSE B=W
80 X1=A*COS(I):Y1=B*SIN(I)
90 X=65+5.4*X1
100 Y=23-2.3*Y1
110 SET(X,Y)
120 NEXT I
130 FOR P=1 TO 300
140 IF INKEY$="" THEN 160
150 PRINT#59,WW/10;
160 NEXT P
170 READ WW:W=WW*N:GOTO 60
180 GOTO 180
190 DATA 8.3,8,7.5,6.7,6.2,5.7,5.4
200 RESUME 180
```

Program Listing 3. The Box

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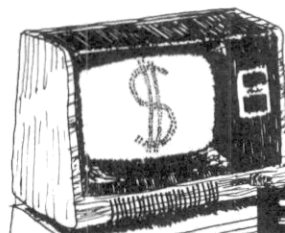
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Write a moving story.

Walking Words

Hubert C. Borrmann
2840 South Circle Dr. #209
Colorado Springs, CO 80906

The value of whatever key has been pressed will be returned to the main program in S6\$; and S1\$ will not be destroyed at exit.

Pressed for Space

There are several comments in the subroutine which you may leave out if pressed for space, but the comments are in fact very handy in any subroutine. The subroutine will shorten messages to 58 positions and will insert one period in front of the message, and two periods at the end. This will make it appear as an unbroken band. The time delay after each execution of the print instruction may be changed in line 10180.

Entry point 10000 will print the message on the bottom line, while entry point 10100 or 10110 bypasses loading the SA. These lines assume that SA was loaded in the main program with the starting address.

Line 10110 fills the "background" with periods. The next three lines adjust the length, determine the highest print position on the line for centering and insert the periods in the message variable.

Line 10150 resets several variables so that S4\$ extracts the characters to be printed out of S1\$ until S4\$ is equal to S1\$. On every pass the effective print position is advanced by one.

S3, which points to position 1 in S1\$, remains one. S2 indicates the number of positions to be extracted and is increased

by one on each pass.

After the complete message appears on the screen (S7 = S9), the length of S4\$ is reduced by one on each pass, controlled by S2.

S3 is increased by one each pass, so that S4\$ extracts the second to the last character out of S1\$. Then the third to the last is extracted etc., until its length is zero. The effective print position remains unchanged.

The program then branches to 10150 and the process is repeated until the test of S6\$ indicates a key or space is depressed. The print line is reset to spaces and the periods are removed from S1\$. This allows a subsequent GOSUB without reloading S1\$.

At this point the subroutine then returns to the main program. I find this routine quite handy, and you might, too. ■

The subroutine described here moves several instructions, or a message, across the TRS-80 screen from right to left, and repeats until any key is pressed. It shortens messages to 58 positions and inserts one period in front of the message and two periods at the end to show messages as unbroken bands.

To use the subroutine, a message is placed in variable S1\$. The variable is linked to the subroutine as follows:

```
100 S1$="TYPE 'SPACE' WHEN
READY"
110 GOSUB 10000.
```

This will move your message on the bottom line from right to left and repeat it. Should you desire to have the message move on another line, place the beginning address of this line in variable SA and link to entry point 10100, as follows:

```
100 S1$="TYPE 'SPACE' WHEN
READY"
110 SA = 512
120 GOSUB 10100.
```

```
10 CLEAR 200 : CLS
20 PRINT@ 128,"INSTRUCTIONS # 1"
30 S1$="PRESS 'SPACE' WHEN READY"
40 GOSUB 10000
50 CLS : PRINT@ 512,"INSTRUCTIONS # 2"
60 SA=640
70 GOSUB 10100
80 CLS : PRINT@ 0,"AND MORE INSTRUCTIONS"
90 S1$="TYPE 'SPACE'-BAR TO CONTINUE, 'E' TO END"
100 GOSUB 10000
110 IF S6$="E" THEN END ELSE 20
10000 SA=960:GOTO 10110 'MOVING-BAND-SUBROUTINE
10010 'AT ENTRY S1$ CONTAINS THE MESSAGE, UP TO 58 CHARACTERS
10020 'AT EXIT S6$ CONTAINS VALUE OF DEPRESSED KEY
10030 'OTHER : S2 = LENGTH OF MESSAGE TO BE DISPLAYED
10040 'VARIABLES : S3 = STARTING POSITION IN STRING
10050 'S4$ = WORKING STRING
10060 'S5 = HIGHEST PRINT ADDRESS ON SCREEN
10070 'S7 = WORK VARIABLE
10080 'S8 = " "
10090 'S9 = LENGTH OF S1$
10100 'SA = START ADDRESS OF LINE ON SCREEN
10110 PRINT@ SA,STRING$(63,".");
10120 S2=LEN(S1$) : IF S2 > 58 THEN S2=58
10130 S5=INT((SA+(64-S2)/2)+S2)
10140 S4$=MID$(S1$,1,S2) : S1$="."+S4$+".."
10150 S7=0 : S9=LEN(S1$) : S2=S9 : S3=1
10160 IF S2=> S7 THEN S2 = S7+1
10170 S4$=MID$(S1$,S3,S2)
10180 PRINT@S5-S7,S4$; : FOR S8=1 TO 15 : NEXT S8
10190 S6$=INKEY$ : IF S6$ <> " " THEN 10230
10200 IF S7=S9 THEN 10220
10210 S7=S7+1 : IF S7 < S9 THEN 10160
10220 S2=S2-1 : S3 = S3+1 : IF S2 < 0 THEN 10150 ELSE 10160
10230 PRINT@ SA,STRING$(63," "); : S1$=MID$(S1$,2,LEN(S1$)-3)
10240 RETURN 'END OF THIS SUBROUTINE
```

Program Listing

A supermarketing program for creatures of impulse.

Mind Your A's & P's

Lois L. Leonard
12733 Stone Canyon Rd.
Poway, CA 92064

Ah, the joys of grocery shopping! Your delight at finding the local social club is meeting in the aisles of your store. The rapture when you realize the next item on your list is on the other side of the market. The treasure hunt to locate where they hide capers.

If that's how you feel about grocery shopping, maybe this article is not for you. This program produces a grocery list that leads you past aisles that contain nothing you need—preventing your buying all those nifty impulse items—and gets you to the check-out counter quickly, saving both time, steps and money.

Groceries Are Data

The program, written on a 16K TRS-80, loads in 7K and runs in over 10K. It requires a printer and a light pen, but can be easily

re-written for keyboard input. The light pen is a simple device that plugs into the tape recorder input port in the back of the keyboard. My pen is from Oasis System and the routine in this program is taken from their instruction manual.

The DATA statements are groceries listed by aisle number. Unless you have the same store layout, a trip to the store with pen and paper is in order. On the same trip study how you shop. Do you like to start at one end or the other?

List each aisle and beneath these headings list the items

you normally use. Leave a blank for novelty foods and rarely purchased items.

If there are a large assortment of items normally purchased on one aisle, make each side a sub-category. For example, see Aisle 11 in the program.

The data for each heading is laid out beginning with an asterisk. The second and third characters are the number of items in the aisle. The remaining characters name the aisle. If an item is dropped or added, the number of items in the list must be changed. Also, an "end" must be used, and it must be counted

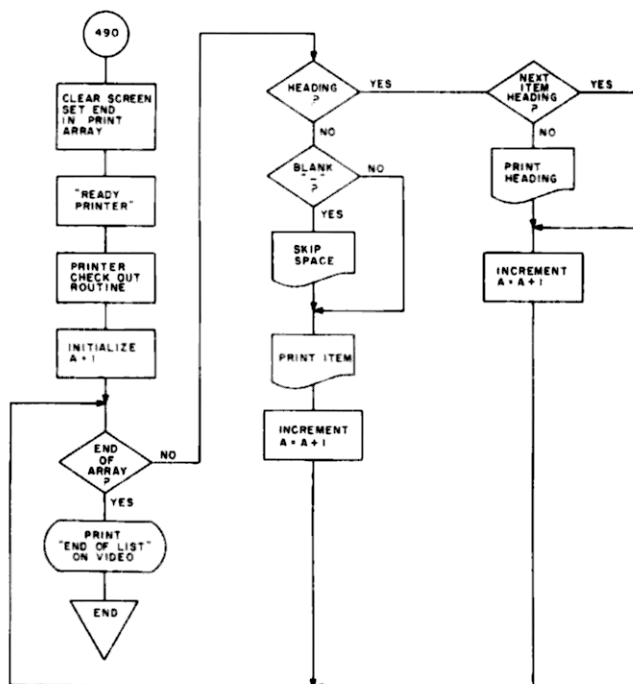


Fig. 1. Printer Routine

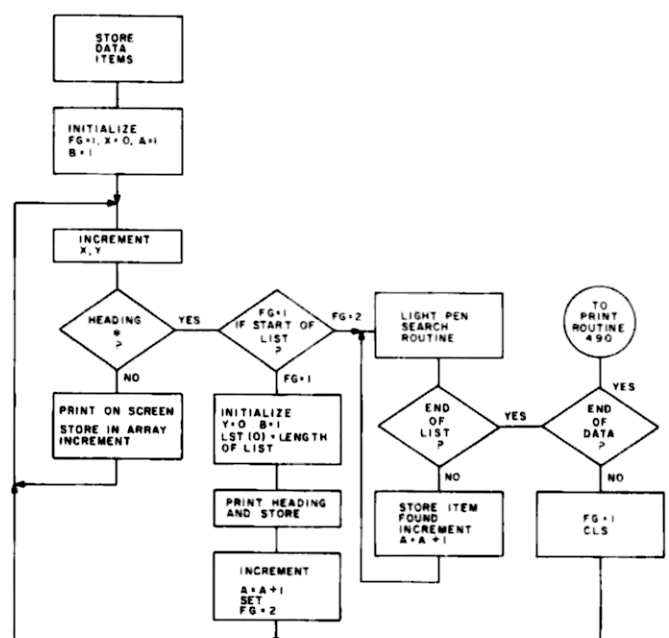


Fig. 2. Grocery List by Light Pen

as an item.

The program is set up with a maximum of 20 items per aisle. More than 20 slows down the light pen search. If the program is to be rewritten for keyboard input, items would be limited only by your screen space.

On items that need further explanation put "-----" in front of them. Examples of this are "-----Jello", "-----spices", "-----jelly". There are too many

varieties of spices to list separately. When "-----spice" is chosen, the printer skips a line before the item and leaves you room to write the name of the spice.

Some of the benefits of this program surprised me. On my first test trip, I was able to do my ordinary shopping minus one-half hour of time. After using it for a month, I found I was buying fewer impulse items. ■

Program Listing

```

10 REM                                GROCERY LIST USING THE LIGHT
    PEN
20 REM                                WRITTEN BY LOIS L. LEONARD
30 REM                                SEPTEMBER 1979
40 REM
50 DIM LT(25),LTS(350),STS(350),LST(40),LSTS(40)
55 REM
60 REM                                READ DATA STATEMENTS INTO
    ARRAYS
70 REM
75 CLS:PRINT# 468,"LOADING DATA"
76 FOR Y = 1 TO 20:READ LT(Y):NEXT Y
80 FOR X = 1 TO 350
100 READ LTS(X)
105 IF LTS(X)="END" THEN GOTO 130
110 NEXT X
130 X=0:A=1:FG=1:B=1
140 REM
150 REM                                PRINT ARRAYS AND TEST FOR
    HEADING
160 REM
165 CLS
170 X=X+1:Y=Y+1
180 IF LEFT$(LTS(X),1)="" THEN GOTO 260
190 PRINT# LT(Y)+4,LTS(X);
195 LST(B)=LT(Y):LSTS(B)=LTS(X):B=B+1
200 GOTO 170
220 REM
230 REM                                HEADING ROUTINE
240 REM
260 IF FG=2 THEN GOTO 360
265 C=LEN(LTS(X)):Y=0
270 PRINT# 20,RIGHT$(LTS(X),C-3)
280 J1$=MID$(LTS(X),2,2)
282 LST(0)=VAL(J1$)
285 B=1
290 ST$(A)=LTS(X)
300 A=A+1
310 FG=2
320 GOTO 170
330 REM
340 REM                                LIGHT PEN SEARCH
350 REM
360 GOSUB 9100
370 IF LSTS(SCAN)<>"END" GOTO 430
375 IF LTS(X)="END" THEN GOTO 490
380 FG=1
385 CLS
390 GOTO 180
400 REM
410 REM                                STORE ITEM FOUND
420 REM
430 ST$(A)=LSTS(SCAN)
440 A=A+1
450 GOTO 360
460 REM
470 REM                                PRINT OUT GROCERY LIST
480 REM
490 CLS
495 ST$(A)="END"
500 PRINT# 468,"READY"
510 PRINT# 468,"HIT ENTER WHEN READY"
520 AS=INKEY$: IF AS="" THEN 520
530 A=PEEK(14312) :PRINT# 468,"CHECK OUT ROU
    TIME
540 IF A=63 GOTO 600
550 IF A=255 PRINT# 468,"PRINTER IS TURNED OFF":GOTO 500
560 IF A=223 PRINT# 468,"YOU HAVE A PAPER PROBLEM":GOTO 500
600 A=1
610 IF ST$(A)="END" THEN PRINT "END OF LIST":END
620 IF LEFT$(ST$(A),1)="" GOTO 660
625 IF LEFT$(ST$(A),1)="-" THEN LPRINT " ":PRINT# 468,"
    TO WRITE
630 LPRINT ST$(A)
640 A=A+1

```

```

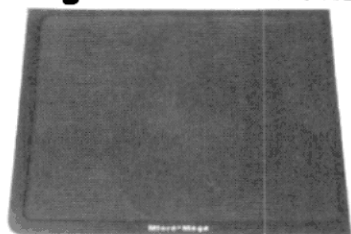
650 GOTO 610
660 IF LEFT$(ST$(A+1),1)="" GOTO 700
670 C=LEN(ST$(A))
680 LPRINT TAB(5) RIGHT$(ST$(A),C-3)
700 A=A+1
710 GOTO 610
9000 OUT 255,0
9010 FOR Z=0 TO 6:NEXT Z
9020 LP=(INP(255) AND 128)
9030 RETURN
9100 REM                                MAGIC LIGHT PEN S
    UBRoutine
9110 L=LST(0)
9120 CS=CHR$(148)
9130 FOR I=1 TO L
9140 PRINT# LST(I),CS;
9150 NEXT I
9160 GOSUB 9000
9170 IF LP=0 GOTO 9160
9180 SCAN=1
9190 PRINT# LST(SCAN)," ";
9200 GOSUB 9000
9210 IF LP=0 GOTO 9260
9220 PRINT# LST(SCAN),CS;
9230 SCAN=SCAN+1
9240 IF SCAN<= L GOTO 9190
9250 GOTO 9160
9260 PRINT# LST(SCAN),CS;
9270 GOSUB 9000
9280 IF LP=0 GOTO 9160
9290 CNT=2
9300 PRINT# LST(SCAN)," ";
9310 GOSUB 9000
9320 PRINT# LST(SCAN),CS;
9330 IF LP<> 0 GOTO 9180
9340 GOSUB 9000
9350 IF LP =0 GOTO 9160
9360 CNT=CNT-1
9370 IF CNT<> 0 GOTO 9380
9380 PRINT# LST(SCAN)-2,"=";
9390 PRINT# LST(SCAN)+1,"=";
9400 GOSUB 9000
9410 IF LP<> 0 GOTO 9400
9420 RETURN
10000 REM                                GROCERY STORE ITEMS
10010 REM                                ALL ITEMS ARE IN GROUPS AS THEY APPEAR
    IN THE
10020 REM                                STORE. ALL HEADINGS HAVE A "*" BEFORE
    THE
10030 REM                                HEADINGS. THE NUMBER AFTER THE "*" WILL
    L
10040 REM                                BE THE NUMBER OF ITEMS IN THE LIST. IF
    YOU
10050 REM                                ADD OR DELETE AN ITEM, REMEMBER TO CHAN
    GE THE
10060 REM                                NUMBER.
10070 REM
10080 DATA 138,202,266,330,394,458,522,586,650,714
10090 DATA 168,232,296,360,424,488,552,616,680,744
10100 DATA *20AISLE 13 - PRODUCE
10110 DATA CANTALOUPE,MUSHROOMS,APPLES,CELERY
10120 DATA CARROTS,PEARS,LETTUCE,CUCUMBERS
10130 DATA TOMATOES,AVOCADOES,SQUASH
10140 DATA BANANAS,POTATOES,CORN,CABBAGE
10150 DATA ONIONS,GRAPEFRUIT,GRAPES,-----
10160 DATA END
10170 DATA *07 BAKERY - REAR OF STORE
10180 DATA BREAD,COFFEE CAKE,WIENER BUNS
10190 DATA HAMBURGER BUNS,BAGELS,-----
10195 DATA END
10200 DATA *11AISLE 13 - DRY FRUIT AND NUTS AND WINES
10210 DATA RAISINS,DATES,PEANUTS,PRUNES
10230 DATA BURGUNDY,CABERNET SAVIGNON,ROSE
10240 DATA LAMBRUSCO,CHABLIS,-----
10250 DATA END
10260 DATA *18AISLE 12 -SOFT DRINKS - DRESSINGS AND SAU
    CES
10270 DATA DIET ROOT BEER,DIET COLA,GINGER ALE
10280 DATA 7-UP,DR. PEPPER
10300 DATA ITALIAN DRESSING,FRENCH DRESSING
10310 DATA GOOD SEASON MIX,MUSTARD,MAYONNAISE
10315 DATA SPAGHETTI SAUCE,TOMATO SAUCE
10320 DATA TOMATO PASTE,CATSUP
10330 DATA BAR-B-Q SAUCE,A-1 STEAK SAUCE
10340 DATA -----,END
10350 DATA *18AISLE 11 - GELATIN AND BAKING SUPPLIES
10360 DATA ----- JELLO,-----PUDDING MIX
10370 DATA FLOUR,WHOLE WHEAT FLOUR,PANCAKE MIX
10380 DATA YEAST,CAKE MIX,FROSTING
10390 DATA DATE NUT BREAD MIX,BANANA BREAD MIX,MAPLE SY
    RUP
10400 DATA CORN STARCH,BAKING POWDER,BAKING SODA
10410 DATA CHOC. CHIPS,CORN SYRUP,-----
10420 DATA END
10430 DATA *13AISLE 11 - SALAD OIL PASTAS SPICES
10440 DATA STOVE TOP STUFFING MIX,RICE
10450 DATA MACARONI AND CHEESE,NOODLES,SPAGHETTI
10460 DATA PARMESAN CHEESE,-----SPICE
10470 DATA SALAD OIL,SHAKE N BAKE,VINEGAR

```

Program continues

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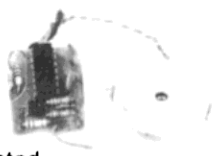
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SEND FOR FULL LINE CATALOG

```

10480 DATA SALT,-----,END
10490 DATA *13AISLE 10 - TEA - COFFEE - SOUP - CEREALS
10500 DATA GROUND COFFEE, INSTANT COFFEE, TEA BAGS
10510 DATA INSTANT TEA, TOMATO SOUP, VEGETABLE SOUP
10520 DATA MUSHROOM SOUP,-----SOUP
10550 DATA RAISIN BRAN, SUGAR, BROWN SUGAR
10560 DATA -----,END
10570 DATA *15AISLE 9 PAPER PRODUCTS
10580 DATA KOTEX, TOILET PAPER, TISSUES
10605 DATA PAPER TOWELS
10610 DATA PAPER NAPKINS, PAPER CUPS, PAPER PLATES
10620 DATA ALUMINUM FOIL, LARGE TRASH BAGS
10630 DATA SMALL TRASH BAGS, PLASTIC WRAP
10640 DATA SANDWICH BAGS, CIGARETTES,-----
10650 DATA END
10660 DATA *12AISLE 8 - TOILETRIES
10670 DATA TOOTH PASTE, BUFFERIN, RUBBING ALCOHOL
10680 DATA TOOTH BRUSH, HAND LOTION, SHAMPOO
10690 DATA CREAM RINSE, DEODORANT, SHAVING CREAM
10700 DATA AFTER SHAVE,-----,END
10710 DATA *13AISLE 8 - FROZEN VEGETABLES
10720 DATA SOY SAUCE, SQUASH, BROCCOLI
10730 DATA PEAS, CARROTS, CORN, SPINACH
10740 DATA BEANS, MIXED VEGETABLES, CUP OF NOODLES
10750 DATA MATZO BALL SOUP MIX,-----
10760 DATA END
10770 DATA *09BACK OF STORE - DAIRY
10780 DATA BEER, MILK, LOWFAT MILK, BUTTER MILK
10790 DATA YOGURT, SOUR CREAM, COTTAGE CHEESE
10800 DATA -----,END
10810 DATA *15AISLE 7 - FROZEN FOOD & JUICES - PICKLES
10820 DATA TV DINNER, CHICKEN PIE, PIZZA
10830 DATA BEEF PIE, LASAGNA
10860 DATA ORANGE JUICE, LEMONADE, COOL WHIP
10870 DATA FROZEN WAFFLES, GREEN OLIVES, BLACK OLIVES
10880 DATA DILLS, GERKINS,-----,END
10890 DATA *16AISLE 6 FROZEN PIES CANDY PRESERVES
10900 DATA ICE CREAM,-----TOPPING, FROZEN PIE
10910 DATA SACCHARIN
10930 DATA POP CORN, CANNED MIXED NUTS, WALNUTS
10940 DATA ALMONDS, MARSHMALLOWS, PEANUT BUTTER
10950 DATA -----JELLY,-----PRESERVE
10960 DATA BATTERIES, LIGHT BULBS,-----
10970 DATA END
10980 DATA *10BACK OF STORE - DELEGATESSEN
10990 DATA EGGS, MARGARINE, BUTTER
11000 DATA -----CHEESE, DINNER ROLLS, BISCUITS
11010 DATA CREAM CHEESE, SLICED AMERICAN CHEESE
11020 DATA -----,END
11030 DATA *08AISLE 5 - PET FOOD AND HARDWARE
11040 DATA CANNED CAT FOOD, DRY CAT FOOD, KITTY LITTER
11050 DATA DOG BISCUITS, SULFODENE, COFFEE FILTERS
11060 DATA -----,END
11070 DATA *13AISLE 4 - WAX - BLEACH
11080 DATA BLEACH, SOFTENER - SHEETS
11090 DATA SOFTENER - LIQUID, RAID, S.O.S PADS
11100 DATA LYSOL, PLEDGE, SILVER POLISH
11110 DATA LIQUID GOLD,-----SHOE POLISH
11120 DATA RUBBER GLOVES,-----,END
11130 DATA *11AISLE 4 - DETERGENT
11140 DATA HAND SOAP, DISH WASHING LIQUID
11150 DATA DISHWASHER DETERGENT, DETERGENT
11160 DATA FANTASTIC, TOILET BOWL CLEANER
11170 DATA COMET CLEANER, PINE SOL
11180 DATA POTATO CHIPS,-----,END
11190 DATA *11AISLE 3 - JUICE - CANNED MILK
11200 DATA NYLONS, TOMATO JUICE, TANG
11210 DATA APPLE JUICE, LEMON JUICE, LIME JUICE
11220 DATA CIDER
11240 DATA EVAPORATED MILK, DRY MILK
11250 DATA -----,END
11260 DATA *13AISLE 2 - CANNED FRUIT - CANNED FISH
11270 DATA PINEAPPLE, PEACHES, PEARS
11280 DATA FRUIT COCKTAIL, GRAPES, APPLE SAUCE
11290 DATA PUMPKIN, TUNA, SARDINES, SALMON
11300 DATA CHILI CON CARNE,-----,END
11310 DATA *12AISLE 2 - CANNED VEGETABLES
11320 DATA WHOLE MUSHROOMS, SLICED MUSHROOMS
11330 DATA -----TOMATOES, GREEN BEANS
11340 DATA PEAS, BEETS, CORN, KIDNEY BEANS
11350 DATA PORK & BEANS, PIMENTOS,-----
11360 DATA END
11370 DATA *17AISLE 1 - MEATS
11380 DATA HAM, TONGUE, CORNED BEEF, PORK CHOPS
11390 DATA LAMB CHOPS, PORK LINKS, ROAST, NY STEAK
11400 DATA RIB EYE STEAK, ROUND STEAK, BEEF CHUCK
11410 DATA -----FISH, CHICKEN - WHOLE
11420 DATA CHICKEN - PARTS, GROUND BEEF,-----
11430 DATA END
11440 DATA *08AISLE 1 - CRACKERS
11450 DATA WHEAT THINS, BREAD CRUMBS, CROUTONS
11460 DATA RITZ CRACKERS, SALTINES, GRAHAM CRACKERS
11470 DATA -----,END
11480 DATA *08FRONT OF STORE - COLD CUTS - FROZEN FISH
11490 DATA BACON, BOLOGNA, SLICED HAM
11500 DATA TURKEY, SHRIMP,-----FISH
11510 DATA -----,END
20000 DATA *END

```

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A cryptic look at coding.

An Article Called Intrepid

Buzz Gorsky
2449 Derbyshire Rd.
Cleveland, OH 44106

If I got 55515255545663877991
9056427336453989798144717
042623356408587926282585037
667841584289885964513482664
245605446486568837350595244
56623893368354 as a message, I
would probably say "Yes that's
true." Of course I would have the
benefit of knowing that the
message decodes to "80 Micro-
computing contains many inter-
esting programming articles."

How did I know that?

In his book *A Man Called Intrepid* (Ballantine Books, New York, 1976), William Stevenson describes some of the effort during World War II by the British to decode German military transmissions. The German code changed with the transmission of each character of a message. Another complicating factor was that a single code machine might send different codes to different recipients.

I have written a series of three

programs which provide the same type of coding and decoding. The first program will generate an original code; the second will encode a message, changing the code for each character of the message; and the third will decode an encoded message.

Simple Principles

The principles of the code are quite simple. A list called C(I) is

als at random and using the ASCII representation of each.

Three of these six carry no significance and exist to confuse things. However, the value of the encoded digit corresponding to the second pair, the third pair and the fifth pair are used by the program.

The value obtained from the sixth pair tells the program how many times to adjust the code in a given direction. Direction im-

code changes with each letter. Further, the way the code changes depends on three of the first six data pairs sent.

In Program Listing 1, (lines 1-90), line 5 prints a big question mark on the screen as a symbol for the encoding program. In line 20 string space is set aside, variables are typed and C is dimensioned.

Line 30 generates a random number between 32 and 95, that is, between the limits for the ASCII set. The first value chosen is assigned to C(1), and each subsequent new value will be assigned to each subsequent C(I) until all values from 32 to 95 are represented.

In line 40, if a new random number (N) is the same as any of the C(I) already in memory, then that N is discarded and a new random number is picked. J counts the number of C(I) existing and when J equals 63 the task is done. Line 50 prints J on the screen so that you can follow the progress of the program.

In line 60 the C(I) are represented as a string Y. This string consists of the concatenated strings of the numerical values

*"The German Code changed
with the transmission
of each character of a message."*

maintained in memory. It has a code value for each ASCII value used by the TRS-80. This represents the initial code at the start of a message.

Each message consists of a string of numerals that may be considered as pairs, each pair representing an encoded ASCII value. The first six pairs are special. These six are chosen by selecting six single-digit numer-

als that the code can be changed by adding or subtracting a fixed amount from each C(I). The value of the second pair is the amount which will be added to C(I). The value of the fifth pair is the amount which will be subtracted.

As the message is generated values are either added or subtracted from C(I) each time a character is encoded. Thus the

of each C(I). Then, in lines 70 and 80, Y is saved on tape. The C(I) could be saved on tape directly, but this method is much faster.

Saving to Tape

The second program, shown in Listing 2, (lines 100-410), acquires the message, encodes it and provides for saving the message on tape and saving the final code on tape. Line 110 takes care of the housekeeping. It retrieves the code from tape and separates Y into the C(I) again.

Line 120 tells the operator that the message can be typed and must not exceed 100 characters. This is a somewhat arbitrary figure, but the message will be stored as a single string and that cannot exceed 255 characters. Since each character of the message is coded as a two-character string representing an encoded ASCII value, the message length can actually reach 127 characters.

The operator is also told that hitting * will erase a character just typed and that hitting / will terminate the message. As the message is entered, the count will change, and the screen will show how many characters are left. The message will appear on the screen in its text and ASCII forms.

In line 130, I is set equal to 94 which is the number of characters remaining. Remember that the first six characters are generated by the program. Line 140 generates the start of the string. A value K is generated randomly as an integer between zero and nine, and a string is made. The string will include a space and a numeral, since the space was saved for the symbol K. Only the right character is taken to get a single character string.

The ASCII value of the string is found, and then a string of the ASCII value is formed. All of that is done by $X = \text{RIGHTS}(\text{STRS}(\text{ASC}(\text{RIGHTS}(\text{STRS}(K), 1))), 2)$. It may seem like a lot of work, but this results in a two-character string that represents the ASCII value of K.

While each of the six Ks is randomly generated, Y is set

equal to $Y + X$. Y is an ever growing string of all the Xs. In line 150 each character of the message is entered using the INKEY\$ function.

If an * is hit, I is increased so that the previous character will be replaced by the next character entered. When / is hit, or when I is zero, the message is ended.

In line 180 the encoding process begins. Y is the uncoded message represented as a string of ASCII values. Since each element of Y is two characters long, J, which equals one-half the length of Y, indicates how many ASCII pairs there are.

In lines 190 to 225 the second, third and fifth ASCII pairs are evaluated to see what numerals they represent. I1, I2 and I3 are set equal to these numerals. I1 will eventually be added to C(I) values when the code is changed, and I2 will be subtracted. I3 will tell how many addition functions to do before switching to subtraction, or vice versa.

In line 230 the construction of Z begins. Z will be a character string representing the encoded ASCII values, and the final message in code. It begins as the first 12 characters of Y, then the rest is the encoded values obtained from the message.

In line 240, X is set equal to two-character string taken from the middle of Y. As I moves along, X will be set sequentially to be each ASCII pair in Y, beginning with the seventh pair, which is where the text of the message actually begins. K is set equal to the value of X minus 32, and then equal to C(K), which is the coded value corresponding to K. For example, $X = 32$, the value of X would be 32 and K would first be set equal to 0 and then to C(0). That would be the coded ASCII value for the space character.

Lines 270 to 350 check how many times the code has been shifted in a given direction and then make the appropriate shift. K0 is a variable which keeps track of whether the code is being shifted by addition or subtraction. When K0 is 0 the code

is being shifted by addition, when it's 1, the code is being shifted by subtraction.

K1 keeps track of how many shifts have been made. This number is compared with I3 and when it equals I3 it is then reset to 0. K0 receives a new value and the opposite shift begins. In 290 to 320 the code is adjusted by adding I1 to each C(I). If any C(I) is then larger than 95 the value is adjusted by subtracting 64. In this way the complete set is maintained.

In lines 330 to 360 the code is adjusted by subtracting I2 from each C(I) value and adding 64 to any which would be less than 32 otherwise. In line 370, I is printed on the screen so that you can see the progress as each character of the code is generated. Following line 380 the coded message and the new code can be saved on tape.

Decoding

Program Listing 3 begins on line 500. This program reads in the original code and the coded

message and then decodes the message. It is analogous to many parts of the second program. First it looks at the first six ASCII pairs and from the second, third and sixth pairs, obtains the values of I1, I2 and I3. It will know how the code is shifted during decoding.

Next it decodes each ASCII pair beginning with the seventh pair. This is done by finding which C(I) equals the value of the particular ASCII pair.

$I = 32$ is the decoded ASCII value and $\text{CHR}\$(K = 32)$ on line 650 finds the decoded character. The string Y is built up of these characters, so that Y will be the decoded message.

K0 and K1 are used, as in the encoding routine, to keep track of how the code is changed. It is changed with the decoding of each character, so that there is a correct code for decoding the next character.

Finally in line 770 the decoded message is displayed. The code is prepared and stored on tape as a single string again. ■

Program listing

```

1 REM 'ENIGMIZER'---CRYPTOGRAPHIC PROGRAM BY BUZZ GORSKY
2 REM FOR 80 MICROCOMPUTING
5 CLS:Y=1:FOR X=35 TO 80:SET(X,Y):NEXT:FOR Y=1TO20:SET(
  X,Y):NEXT:Y=20:FOR X=80 TO 48 STEP -1:SET(X,Y):NEX
  T:X=48:FOR Y=20 TO 35:SET(X,Y):NEXT:SET(X,Y+1):SET
  (X,Y+2):FOR I=1TO5000:NEXT
10 CLS:REM ROUTINE TO GENERATE ORIGINAL CODE
20 CLEAR450:DEFINT C,I,J:DEFSTR X,Y,Z:DIM C(63):RANDOM
30 N=RND(95):IF N<32 THEN 30
40 FOR I=0 TO J:IF N=C(I) THEN 30
50 NEXT I:C(J)=N:IF J<63 THEN J=J+1:PRINT#540,J:GOTO30
60 FOR I=0 TO 63:X=RIGHT$(STR$(C(I)),2):Y=Y+X:NEXT
70 INPUT"PREPARE TAPE TO SAVE CODE":Z
80 PRINT#-1,Y
90 END
100 REM ROUTINE TO ENCODE MESSAGE THEN SAVE MESSAGE, EN
  CODED MESSAGE, AND NEW CODE
110 CLEAR 1000:DEFINT C,I,J,K:DEFSTR X,Y,Z:DIM C(63):R
  ANDOM:INPUT"TAPE READY TO INPUT CODE":X0:INPUT#-1,Y
  :FOR I=0 TO 63:C(I)=VAL(MID$(Y,I*2+1,2)):NEXT:Y=""
120 CLS:PRINT "ENTER MESSAGE. DO NOT EXCEED 100 CHARACT
  ERS.":PRINT "END WITH '/' : USE '*' TO DELETE LAST L
  ETTER"
130 PRINT "CHARACTERS REMAINING--":PRINT:I=94
140 FOR J=1TO6:K=RND(9):X=RIGHT$(STR$(ASC(RIGHT$(STR$(K
  ),1))),2):Y=Y+X:NEXT J
145 PRINT#512,I:IF I=0 THEN 170
150 X=INKEY$:IF X="" THEN 155 ELSE IF X="/" THEN 170 E
  LSE IF X="" THEN 150 ELSE 160
155 Y=LEFT$(Y,LEN(Y)-2):Z=LEFT$(Z,LEN(Z)-1):I=I+1:GOTO1
  45
160 Z=Z+X:Y=Y+RIGHT$(STR$(ASC(X)),2):PRINT#512,Y:I=I-1:
  PRINT#768,Z:GOTO145
170 CLS
180 J=LEN(Y)/2:FOR I=2 TO 5:IF I=4 THEN NEXT I
190 X=MID$(Y,2*I-1,2)
200 IF I=2 THEN I1=VAL(CHR$(VAL(X)))
210 IF I=3 THEN I2=VAL(CHR$(VAL(X)))
220 IF I=5 THEN I3=VAL(CHR$(VAL(X)))
225 NEXT I
230 Z=LEFT$(Y,12):FOR I=7 TO J
240 X=MID$(Y,2*I-1,2)
250 K=VAL(X)-32:K1=K1+1

```

Program Continued

```

260 K=C(K):Z=Z+RIGHT$(STR$(K),2)
270 IF K0<>0 THEN 280 ELSE IF K1<13 THEN 290 ELSE K1=0:
    K0=1:GOTO330
280 IF K1<13 THEN 330 ELSE K1=0:K0=0
290 FOR J1=0 TO 63
300 IF C(J1)+I1>95 THEN C(J1)=C(J1)-64
310 C(J1)=C(J1)+I1
320 NEXT J1:GOTO370
330 FOR J1=0 TO 63
340 IF C(J1)-I1<32 THEN C(J1)=C(J1)+64
350 C(J1)=C(J1)-I2
360 NEXT J1
370 PRINT#500,I: NEXT I
380 CLS:PRINT"ENCODING COMPLETE":INPUT"TAPE READY TO SA
    VE CODED MESSAGE";X0:PRINT#-1,Z:INPUT"LINEPRINT OF
    CODED MSG";X0:IF X0="Y" THEN LPRINT Z
390 FOR I=0 TO 63:Y0=Y0+RIGHT$(STR$(C(I)),2):NEXT
400 INPUT"TAPE READY TO SAVE NEW CODE";Z:PRINT#-1,Y0
410 END
500 REM ROUTINE TO DECODE MESSAGE AND SAVE NEW CODE
510 CLEAR 1000:DEFINT C,I,J,K:DEFSTR X,Y,Z:DIM C(63)
520 INPUT"TAPE READY TO ENTER CODED MESSAGE";X:INPUT#-1
    ,Z:INPUT"TAPE READY TO INPUT CODE";X0:INPUT#-1,Y0
530 FOR I=0 TO 63
540 C(I)=VAL(MID$(Y0,2*I+1,2)):NEXT
550 J=LEN(Z)/2:FOR I=2 TO 5:IF I=4 THEN NEXT I
560 X=MID$(Z,2*I-1,2)
570 IF I=2 THEN I1=VAL(CHRS$(VAL(X)))

```

```

580 IF I=3 THEN I2=VAL(CHRS$(VAL(X)))
590 IF I=5 THEN I3=VAL(CHRS$(VAL(X)))
600 NEXT I
610 FOR I=7 TO J
620 X=MID$(Z,2*I-1,2)
630 K2=VAL(X):K1=K1+1
640 FOR K=0 TO 63:IF C(K)<>K2 THEN NEXT K
650 Y=Y+CHRS$(K+32)
660 IF K0<>0 THEN 670 ELSE IF K1<13 THEN 680 ELSE K1=0:
    K0=1:GOTO720
670 IF K1<13 THEN 720 ELSE K1=0:K0=0
680 FOR J1=0 TO 63
690 IF C(J1)+I1>95 THEN C(J1)=C(J1)-64
700 C(J1)=C(J1)+I1
710 NEXT J1:GOTO 760
720 FOR J1=0 TO 63
730 IF C(J1)-I1<32 THEN C(J1)=C(J1)+64
740 C(J1)=C(J1)-I2
750 NEXT J1
760 PRINT#564,I: NEXT I
770 CLS:PRINT"DECODED MESSAGE:":PRINT:PRINTY
780 Y0="":FOR I=0 TO 63:Y0=Y0+RIGHT$(STR$(C(I)),2):NEXT
790 INPUT"IS TAPE READY TO RECORD NEW CODE";X0:PRINT#-1
    ,Y0

```

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From the original author of *Roots and Branches*

Personal Computing magazine September 1979

*TRS-80 is a registered trademark of Tandy Corp.

UCSD* System for TRS-80 Model II†

The most portable operating system now supports FORTRAN. Pascal and/or FORTRAN modules are compiled in universal P-code, so they can run on most microprocessors, often without recompiling. Programs execute up to 10 times faster than comparable BASIC programs, and use much less memory. Ready to run on TRS-80 Model II (64K).

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- Configuration program for serial I/O.
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DOCUMENTATION

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- Beginner's Guide To UCSD Pascal.
- Pascal User Manual & Report.
- Fortran User's Manual with Fortran systems.

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- UCSD System with Pascal Compiler \$350
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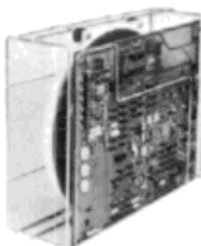
PCD Systems is a licensed distributor of the UCSD System for Pascal and Fortran. Dealer inquiries are invited.

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THE PRIAM LINEUP

Model/Disk Size	Capacity	Size	Weight	Price
DISKOS 3350 (14")	33 Mbytes	7" x 17" x 20"	33 lbs.	\$2995
DISKOS 6650 (14")	66 Mbytes	7" x 17" x 20"	33 lbs.	\$3749
DISKOS 15450 (14")	154 Mbytes	7" x 17" x 20"	33 lbs.	\$4695
DISKOS 2050 (8")	20 Mbytes	4.62" x 8.55" x 14.25"	20 lbs.	\$2995
DISKOS 3450 (8")	34 Mbytes	4.62" x 8.55" x 14.25"	20 lbs.	\$3745
DISKOS 570	5.3 Mbytes	5.1" x 5.1" x 1.1"	(low)	(low)
DISKOS 1070	10.6 Mbytes	5.1" x 5.1" x 1.1"	(low)	(low)

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SIRIUS SYSTEMS offer cases and enclosures for all PRIAM Hard Disk Drives. All 14" Winchester Drives will mount in our 14" Standard Case. The 8" Winchester have two alternatives: a single drive case and a dual drive case. All SIRIUS SYSTEMS Winchester drive cases include Power Supply, internal cabling, switches, fan, extra AC outlet (not switched, but fused) and possess very adequate ventilation. Drive addressing is done on the rear of the Case and not on the drive itself to provide ease of use during operation. All WINCHESTER DRIVE Cases are Warranted for a full year and come in our standard blue-black color scheme. Consult us for current availability and pricing.

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RFD 4001, \$569.95

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RFD 4000/4001 Technical Manual	6.95	RFD 4000C/B Cabinet (for use with Power Modules)	29.95
Connector Set #3 (AC, DC, Card Edge)	10.95		
Connector Set #4 (AC and DC)	2.95		

Remex 1000B ... If you've been looking for a less expensive floppy disc drive, but not wanting to sacrifice quality— this is it!

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You get both in the Remex 1000B! For only \$419.95 look at what you get: ■ 8" Floppy Drive ■ Single or Double Density ■ Hard or Soft Sectoring ■ Media Protection Feature ■ Single Density Data Separator ■ 180 Day Factory Warranty

Door Lock Option	\$19.95	Write Protect Option	\$19.95	RFD 1000B Technical Manual	\$5.95
Interface Adapter (REMEX-to-Shugart)	\$14.95	Connector Set #1 (AC, DC, & Card Edge)	\$10.95	RFD 1000B CASE (for use with Power Modules)	\$29.95

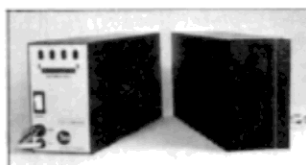
SIRIUS 8" DISK POWER MODULES

The Single and Dual Drive Power Modules are designed to provide DC and (switched) AC power for one (the Single Drive Power Module) or two (the Dual Drive Power Module—the DOPM) will power three RFD 4000s or 4001s) 8" Floppy Disk Drives. Many features are included for safe and reliable operation and the Power Modules come with our standard

180 day WARRANTY (the Open Frame Power Supply warranty is for 2 years). All Power Modules will work with either the RFD 4000C/B or RFD 1000B case (color schemes match also).

Dual Drive Power Module (DOPM)	\$139.95
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The SIRIUS SYSTEMS 80+ Series of Floppy Disk add-ons are designed to provide unmatched versatility and performance for your computer. Consisting of four different add-ons, there is a 80+ Series Floppy Disk to meet your need. All 80+ Series Floppy Disk are compatible with the TRS-80+ and come ready to plug in!

COMMON CHARACTERISTICS

- 5 ms track-to-track access time
- Auto-eject
- 180 day WARRANTY
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- Ultra high reliability
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- Mix any or all 80+ Series on the same cable!
- Includes user accessible plugboard for drive reconfiguring

SPECIFIC CHARACTERISTICS

The SIRIUS 80+1 is a single sided, 40 track, highly reliable Floppy Disk add-on. Offering 5 more tracks than the Radio Shack model, it cost \$140 less! Formatted data storage is 102K/20K bytes single/double density.

SIRIUS 80+1 \$359.95

The SIRIUS 80+2 is a dual sided, 70 track (35 per side), highly versatile Floppy Disk unit. It appears to the TRS-80+ as TWO 35 track drives, yet COST LESS THAN HALF THE PRICE! Even greater savings result, since data is recorded on both sides of the media instead of only a single side. Using the plug board, it may be reconfigured for other computer systems! (The 80+2 operates as Drive 0 and any of the other three addresses (with the standard Radio Shack Cable) or as any of four drives (with the SS Standard Cable).) Formatted data storage is 80.6K/161.2K bytes single/double density.

SIRIUS 80+2 \$449.95

The SIRIUS 80+3 is a single sided, 80 track, "Quad" density Floppy Disk unit. Offering 2 1/2 times the storage of a Standard Radio Shack drive, the 80+3 greatly reduces the need for diskettes correspondingly. Additionally, because of the increased storage and faster track-to-track access time, the 80+3 allows tremendously increased throughput for disk based programs!!! The 80+3 INCLUDES SIRIUS's TRAKS-PATCH on Diskette. Formatted data storage is 204K/40K bytes single/double density.

SIRIUS 80+3 \$489.95

The SIRIUS 80+4 Floppy Disk add-on is a double sided, 160 track (80 per side), 5 1/4" monster! The ultimate in state-of-the-art 5 1/4" Floppy Disk technology, to 80+4 is seen by the TRS-80+ as two single sided disk drives, each with 80 tracks. Thus, in terms of capacity one 80+4 is equivalent to 4% standard Radio Shack drives—a savings of over 73% (not to mention diskettes!!!). (With a double density converter, the available memory is huge!) The 80+4 is similar to the 80+2 in that it arrives configured as Drive 0 and any of the other three addresses (with the standard Radio Shack Cable) or as any of four drives (with the SS Standard Cable). The 80+4 INCLUDES TRAKS-PATCH on Diskette. (The plug board is also included.) Formatted data storage is 408K single density or 816K bytes double density.

SIRIUS 80+4 \$624.95

All 80+ Series Floppy Disk add-ons operate a 5 milliseconds track-to-track access time (eight times faster than the SA 400) but are Expansion Interface Limited to 12 milli-seconds for the TRS-80+.

*TRS-80(ig) Tandy Corp.

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SPECIFIC HARDWARE FEATURES INCLUDE:

- Control of up to twelve Floppy Disk Drives (eight 8" and/or four 5 1/4")
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- Control of up to four WINCHESTER type PRIAM DISKOS Disk Drives
 - 8" or 14" may intermix on the same cable
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- Extremely flexible host-controller interfacing

SPECIFIC SOFTWARE FEATURES INCLUDE:

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- Operates in either get/put sector mode or data string mode
- Performance parameters may be changed by EPROM replacement or Dynamic Reprogramming

Dedicated systems cards are also available on a limited basis for the STD-BUS and the S 100. These cards feature shared memory also (again, software selectable) in addition to the regular OMEGA Series Controller Module features. Consult SIRIUS SYSTEMS for current prices and availability for the entire line of OMEGA Series Memory Units and Controllers. Dealer inquiries are invited.

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Bach to BASIC!

Music Note Recognition

J. David McClung
P.O. Box 1590
Dallas, TX 75221

My wife and I bought our TRS-80 partly to help with our children's educations. We didn't realize then how very little educational software was available. I turned, therefore, to writing my own.

Music Note Recognition is a program I wrote to teach my two oldest children how to read music. The program displays either a treble clef or a bass clef with a single whole note. The child is asked to name the note within a previously selected time. After 20 notes, the responses are evaluated and the incorrect ones reviewed.

Six Steps

I follow six steps when debugging a program. Step one clearly defines the lesson. Children learn more quickly when lessons are simple. For example, in Music Note Recognition I could have included sharps, flats or fractional notes. Instead, I

limited the lesson to whole natural notes.

Step two presents the lesson facts. Most educational programs I have seen fail by asking questions before the student has a chance to study the material. My children quickly lose interest in a program, if it asks them several questions in a row that they cannot answer. Programs are more effective if the lesson is presented before testing begins.

In Music Note Recognition, line 240 lets the child review the lesson. In the subroutine beginning at line 1400, each note is presented with its name. The child can study as long as necessary before beginning the test.

Step three tests the child's knowledge. The test is the heart of any educational program. The student should be allowed to demonstrate his knowledge of the material.

I try to make the test questions active, varied and interesting. My children lose interest, if the program repeats the same questions in the same sequence

each time the program is run. I use the TRS-80 random generator to vary the order of the questions. I also include protection to prevent repeating the same question too often.

In Music Note Recognition, lines 420-440 select the sequence of questions. Each question is compared to previously selected questions to prevent duplication. Thus, 20 of the 33 possible questions are presented each time the program is run, but in different sequences.

Children respond best to programs that have a lot of action on the CRT. For example, this music program redraws the entire staff for each test question rather than merely moving the note. The extra action helps hold the child's attention.

Include Challenges

If the program is going to be useful for more than a few runs, the test must become more difficult as the student masters the lesson. You can challenge the student by limiting the time allowed for each answer.

The value of H selected in line

320 determines the time allowed. In my computer, I must multiply the number of seconds selected by 40. If the program is used without a keyboard debounce routine, the 40 must be increased. The correct value can be established by experimentation.

The program responds to each answer immediately, correcting a child's responses. This feature makes the computer especially valuable as a teaching tool. Lines 560-580 confirm the answer given or tell the child what the correct answer was.

Step four evaluates the results. An evaluation should encourage the student to study. An effective educational program will evaluate how well the child has learned the lesson and encourage the child to perform better. I try to present the evaluation in a positive manner.

For my older children, I use their school's grading scale. They are shown the percentage correct and a letter grade. For younger children, I use "Great," "Good," "Fair" or "Need more

the electric pencil II™

© 1980 Michael Shroyer

for the TRS-80 Model II* Computer



The Electric Pencil is a Character Oriented Word Processing System. This means that text is entered as a continuous string of characters and is manipulated as such. This allows the user enormous freedom and ease in the movement and handling of text. Since lines are not delineated, any number of characters, words, lines or paragraphs may be inserted or deleted anywhere in the text. The entirety of the text shifts and opens up or closes as needed in full view of the user. Carriage returns as well as word hyphenation are not required since each line of text is formatted automatically.

As text is typed and the end of a screen line is reached, a partially completed word is shifted to the beginning of the following line. Whenever text is inserted or deleted, existing text is pushed down or pulled up in a wrap around fashion. Everything appears on the video display screen as it occurs thereby eliminating any guesswork. Text may be reviewed at will by variable speed or page-at-a-time scrolling both in the forward and reverse directions. By using the search or the search and replace function, any string of characters may be located and/or replaced with any other string of characters as desired. Specific sets of characters within encoded strings may also be located.

When text is printed, The Electric Pencil automatically inserts carriage returns where they are needed. Numerous combinations of Line Length, Page Length, Character Spacing, Line Spacing and Page Spacing allow for any form to be handled. Right justification gives right-hand margins that are even. Pages may be numbered as well as titled.

the electric pencil

—a Proven Word Processing System

The TRSDOS versions of The Electric Pencil II are our best ever! You can now type as fast as you like without losing any characters. New TRSDOS features include word left, word right, word delete, bottom of page numbering as well as extended cursor controls for greater user flexibility. BASIC files may also be written and simply edited without additional software.

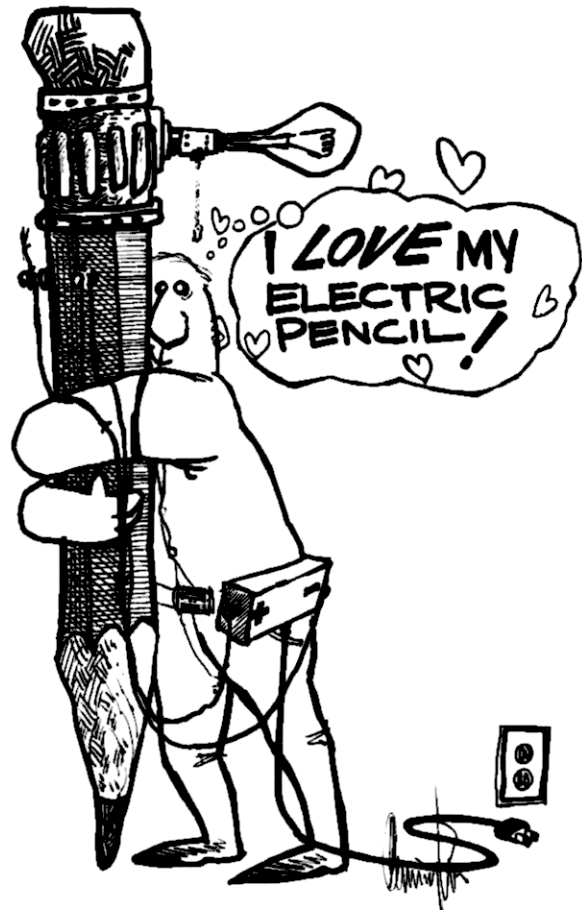
Our CP/M versions are the same as we have been distributing for several years and allow the CP/M user to edit CP/M files with the addition of our CONVERT utility for an additional \$35.00. CONVERT is not required if only quick and easy word processing is required. A keyboard buffer permits fast typing without character loss.

	CP/M	TRSDOS
Serial Diablo, NEC, Gume	\$ 300.00	\$ 350.00
All other printers	\$ 275.00	\$ 325.00

The Electric Pencil I is still available for TRS-80 Model I users. Although not as sophisticated as Electric Pencil II, it is still an extremely easy to use and powerful word processing system. The software has been designed to be used with both Level I (16K system) and Level II models of the TRS-80. Two versions, one for use with cassette, and one for use with disk, are available on cassette. The TRS-80 disk version is easily transferred to disk and is fully interactive with the READ, WRITE, DIR, and KILL routines of TRSDOS.

TRC	Cassette	\$ 100.00
TRD	Disk	\$ 150.00

✓ 255



Features

TRSDOS or CP/M Compatible * Supports Four Disk Drives * Dynamic Print Formatting * Diablo, NEC & Gume Print Packages * Multi-Column Printing * Print Value Chaining * Page-at-a-time Scrolling * Bidirectional Multispeed Scrolling * Subsystem with Print Value Scoreboard * Automatic Word & Record Number Tally * Global Search & Replace * Full Margin Control * End of Page Control * Non Printing Text Commenting * Line & Paragraph Indentation * Centering * Underlining * Boldface



* TRS-80 is a registered trade mark of Radio Shack, a division of Tandy Corp.



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practice." For pre-schoolers I use a smiling face or a sad face.

Reviews and Invitations

Step five reviews incorrect answers. When the child answers a test question incorrectly, the computer provides the correct one. In addition, the

questions answered incorrectly are reviewed following the evaluation. Line 800 repeats each missed question, until answered correctly.

Step six concludes with an invitation to try again. I try to end every educational program this way. The student should be

praised for good work, but encouraged to achieve higher scores or shorter response times. Such challenges keep the program interesting.

My children have enjoyed learning by computer so much that my 12-year-old daughter, LeEtta, and my 10-year-old son,

Denny, are beginning to write their own simple programs. The educational usefulness of the TRS-80 is limited only by the availability of software. With a little practice any computer owner can write programs that challenge and teach the student. ■

Program Listing

```

40 CLEAR 150:GOTO 210: 'SKIP INPUT ROUTINE
100 'INPUT ROUTINE AND TIMING LOOP
110 FOR L=1 TO 10:IS=INKEY$
120 IF IS>="A" AND IS<="G":PRINT IS:RETURN
130 IF IS<>" " PRINT @, "ANSWER A,B,C,D,E,F OR G
      "
140 NEXT L:RETURN
200 'BEGIN PROGRAM
210 CLS:M$=STRING$(63,"-"):DIMA(20):DIME(20):R=0:W=0:K$=
  STRING$(3,CHR$(191))
220 CLS:PRINT@20,"MUSIC NOTE RECOGNITION":PRINT:PRINT@7
  4,"(C) 1980 BY DAVE MCCLUNG, RICHARDSON, TX"
230 PRINT:PRINT"THIS PROGRAM IS DESIGNED TO TEACH MUSIC
  STUDENTS THE NAMES":PRINT"OF EACH LINE AND SPACE.
  ":PRINT:PRINT"THE QUIZ WILL CONSIST OF 20 QUESTION
  S.":PRINT:PRINT
240 PRINT:INPUT "DO YOU WANT TO REVIEW ";Z$
250 IF LEFT$(Z$,1)="Y" GOTO 1400
300 'GET INFORMATION
310 CLS:INPUT "WHAT IS YOUR NAME ";N$
320 PRINT:INPUT "HOW MANY SECONDS FOR EACH QUESTION ";H
  :H=H*40
330 '59 SECONDS MAXIMUM
340 IF H>2360 PRINT"YOU CAN'T HAVE THAT LONG":PRINT:GOTO
  320
400 'SELECT TEST QUESTIONS -- NO REPEATS
410 PRINT:PRINT"STANDBY -- THE COMPUTER IS SELECTING TH
  E QUESTIONS"
420 FOR X=1 TO 20
430 A(X)=RND(23):FOR Y=0 TO (X-1):IF A(Y)=A(X) GOTO 430
  ELSE NEXT Y
440 NEXT X
500 'TEST
510 FOR G=1 TO 20:N=A(G)
520 GOSUB 1000:GOSUB 1110
530 IF C=1 GOSUB 1210 ELSE GOSUB 1310
540 IF S=924 OR S=156 PRINT@S,"---+K$+---"; ELSE PRINT@
  S,K$;
550 PRINT@S,"*";G$; " "; "WHAT IS THE NAME OF THIS NOTE";
  :GOSUB 110
560 PRINT@S,STRING$(63,"-"):IF IS=Q$ R=R+1:PRINT@S,"COR
  RECT":GOTO 590
570 IF IS<>Q$ AND IS<>" "PRINT@S,"WRONG! THE NOTE IS ";
  Q$;:P=P+1:E(P)=A(G)
580 IF IS="" PRINT@S,"YOUR TIME IS UP! THE NOTE IS ";Q
  $;:P=P+1:E(P)=A(G)
590 GOSUB 1600:NEXT
600 'EVALUATE TEST RESULTS
610 CLS:PRINTCHR$(23):PRINT"TEST RESULT":PRINT:PRINTN$;
  " "; "YOUR TEST RESULT IS:"
620 PRINT:PRINT"NUMBER CORRECT = ";R
630 W=20-R
640 PRINT"NUMBER MISSED = ";W
650 PRINT"SCORE = ";U=((R/20)*100):PRINTUSING
  "###";U
660 PRINT"GRADE = ";
670 IF U<60PRINT"F"
680 IF U>59 AND U<70 PRINT"D"
690 IF U>69 AND U<80 PRINT"C"
700 IF U>79 AND U<90 PRINT"B"
710 IF U>89 PRINT"A"
720 PRINT:IF U=100 PRINT"YOU DID GREAT!":GOTO 900
800 'REVIEW THE QUESTIONS MISSED
810 PRINT:PRINT"TO RECHECK THE ONES YOU MISSED -- HIT E
  NTER":INPUT Z$
820 CLS:FOR O=1 TO (20-R)
830 N=E(O):GOSUB 1000:GOSUB 1110
840 IF C=1 GOSUB 1210 ELSE GOSUB 1310
850 IF S=924 OR S=156 PRINT@S,"---+K$+---"ELSEPRINT@S,K
  $;
860 PRINT@S,"TRY THIS ONE AGAIN ";:GOSUB 110:PRINT@S,ST
  RING$(63,"-"):IF IS=Q$ PRINT@S,"CORRECT! ":GOTO 88
  0
870 PRINT@S,"WRONG!":GOSUB 1600:GOTO 860
880 GOSUB 1600:NEXT O
890 CLS:PRINTCHR$(23):PRINT"CONGRATULATIONS, ";N$:PRINT
  :PRINT:PRINT"YOU GOT THEM ALL!":GOSUB 1600:PRINT:P
  RINT"FINALLY":PRINT:GOSUB 1600:PRINT"AFTER MUCH EF
  FORT"
900 PRINT:PRINT"TO TAKE THE TEST AGAIN -- HIT ENTER":IN
  PUT Z$:RUN

1000 'SELECT NOTE
1010 ON N GOTO 1020,1021,1022,1023,1024,1025,1026,1027,
  1028,1029,1030,1031,1032,1033,1034,1035,1036,1037,
  1038,1039,1040,1041,1042,1043
1020 Q$="G":S=222:C=1:RETURN
1021 Q$="F":S=286:C=1:RETURN
1022 Q$="E":S=350:C=1:RETURN
1023 Q$="D":S=414:C=1:RETURN
1024 Q$="C":S=478:C=1:RETURN
1025 Q$="B":S=542:C=1:RETURN
1026 Q$="A":S=606:C=1:RETURN
1027 Q$="G":S=670:C=1:RETURN
1028 Q$="F":S=734:C=1:RETURN
1029 Q$="E":S=798:C=1:RETURN
1030 Q$="D":S=862:C=1:RETURN
1031 Q$="C":S=924:C=1:RETURN
1032 Q$="C":S=156:C=2:RETURN
1033 Q$="B":S=222:C=2:RETURN
1034 Q$="A":S=286:C=2:RETURN
1035 Q$="G":S=350:C=2:RETURN
1036 Q$="F":S=414:C=2:RETURN
1037 Q$="E":S=478:C=2:RETURN
1038 Q$="D":S=542:C=2:RETURN
1039 Q$="C":S=606:C=2:RETURN
1040 Q$="B":S=670:C=2:RETURN
1041 Q$="A":S=734:C=2:RETURN
1042 Q$="G":S=798:C=2:RETURN
1043 Q$="F":S=862:C=2:RETURN
1100 'PRINT STAFF
1110 CLS:PRINT@256,M$:PRINT:PRINTM$:PRINT:PRINTM$:PRINT
  :PRINTM$:PRINT:PRINTM$
1120 RETURN
1200 'DRAW TREBLE CLEF
1210 FOR D=9 TO 40:SET(21,D):NEXT D
1220 RESTORE
1230 FOR D=1 TO 61:READ A,B:SET(A,B):NEXT D
1240 DATA 10,30,10,31,11,29,10,32,10,33,11,34,12,28,12,
  35,13,27,13,36,14,26,14,36,15,25,15,31,15,32,15,37
  ,16,24,16,30,16,37,17,23,17,29,17,37,18,22,18,28,1
  8,37,19,21,19,27,19,37,20,20,20,26,20,37
1250 DATA 22,9,22,19,22,26,22,37,23,10,23,18,23,26,23,3
  6,23,37,24,11,24,17,24,27,24,35,24,36,25,12,25,16,
  25,27,25,28,25,34,25,35,26,13,26,14,26,15,26,28,26
  ,29,27,30,27,31,27,32,26,33,26,34
1260 RETURN
1300 'BASS CLEF
1310 RESTORE:FOR X=1 TO 61:READ A,B:NEXTX:FOR X=1 TO 92:RE
  AD V,K:SET(V,K):NEXT X:RESTORE:RETURN
1320 DATA 9,18,9,19,10,17,10,18,10,19,11,16,11,17,11,19,
  11,20,12,15,12,16,12,19,12,20,13,15,13,19,13,20,14
  ,14,15,13,15,14,15,38,15,39,16,13,16,37,16,38,17,1
  3,17,36,17,37,18,13,18,35,18,36
1330 DATA 19,13,19,35,19,34,20,13,20,34,20,33,21,13,21,3
  3,21,32,22,14,22,32,22,31,23,14,23,15,23,31,23,30,
  24,15,24,16,24,30,24,29,25,16,25,17,25,28,25,29,26
  ,17,26,18,26,27,26,28,27,18,27,19,27,26,27,27
1340 DATA 28,19,28,20,28,21,28,22,28,23,28,24,28,25,28,2
  6,29,20,29,21,29,22,29,23,29,24,29,25,30,21,30,22,
  30,23,30,24,32,15,32,16,32,17,32,21,32,22,32,23,33
  ,15,33,16,33,17,33,21,33,22,33,23
1400 'REVIEW TREBLE
1410 CLS:PRINT@S,"TREBLE CLEF"
1420 GOSUB 1110
1430 GOSUB 1210
1440 FOR N=1 TO 12:GOSUB 1000:
1450 IF N/2=INT(N/2) S=S+10
1460 IF S=934 OR S=166 PRINT@S,"---+K$+---" "+Q$; EL
  S PRINT @S,K$+" "+Q$;
1470 NEXT N:PRINT@988," TO REVIEW BASS CLEF - HIT ENTE
  R ";:INPUT Z$
1480 CLS
1490 GOSUB 1110
1500 GOSUB 1310
1510 PRINT@S,"BASS CLEF"
1520 FOR N=13 TO 24:GOSUB 1000
1530 IF N/2=INT(N/2) S=S+10
1540 IF S=924 OR S=156 PRINT @S,"---+K$+---" "+Q$; EL
  S PRINT @S,K$+" "+Q$;
1550 NEXT N:PRINT@988,"TO PROCEED WITH QUIZ - HIT ENTER
  ";:INPUT Z$
1560 GOTO 310
1600 'PAUSE
1610 FOR Y=1 TO 1000:NEXT:RETURN
1700 END

```

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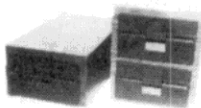
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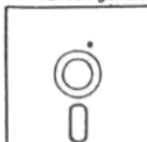
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Deep in the heart of ROM.

BINAX KIBUFF

John T. Blair
122 Dumont Ave.
Norfolk VA 23505

In an attempt to break Microsoft's BASIC for the TRS-80, several of our club members have spent many sleepless nights tearing through the listings of the Level II ROM's. What follows is some of the fruits of their labors and we hope that some of the newer machine language programmers can save some time by calling on the following information.

DELAY is used for time delays. Load the BC registers with a number between one and FFFF Hex (H). When DELAY is called, a return will occur approximately

$(28 \cdot (N - 1) + 31) \cdot 563.67$ Nanoseconds

later. This routine is located at 0060H.

```
LD BC,XXXX ;where XXX = delay time
CALL 0060H
```

CLS is used to clear the screen and home the cursor. It is located at 01C9H.

KIBUFF reads the keyboard into a buffer until a carriage return (CR) is entered, then it returns to the calling routine. The starting address of the buffer is contained in 40A7H, noted by programmers as (40A7H) and is initialized to 41E8H. This can be changed by the user if desired. This routine resides at 0361H.

```
CALL 0361H
```

BINAX is used to convert a binary number in the HL register to its ASCII equivalent. The ASCII value is in a buffer beginning at 4130H. The contents of 4130H, (4130H), is always equal to 20H.

The contents of 4131H to 4135H will have the decimal ASCII characters. (4136H) will always be 00H.

```
CALL 0FAFH
```

AXBIN converts from ASCII to binary. Load the HL register pair with the address of the first ASCII character to be converted. On return the DE register contains the binary equivalent. The maximum number which can be converted is 65529. This routine is located at 1E5AH.

```
LD HL,XXXX ;XXXX is address of
;char. to be converted
CALL 1E5AH ;call convert routine
LD A,(DE) ;Acc. contains the
;binary value
```

OUTSTR will output a string of characters from memory to the CRT. Load the HL register with the address of the first character. Characters are output until either a OOH or 22H is found. OUTSTR is located at 28A7H. (Note: Since the addition of a disk I have found this routine may or may not work. It will work if the system is brought up in BASIC2, non disk based BASIC.)

VIDEO displays any character in the 'A' on the CRT. You must push the DE register onto the stack before calling this routine. It is located at 0033H.

```
PUSH DE ;save DE
CALL 0033H ;display character
```

```
POP DE ;restore DE
```

PRNTR, the printer driver routine, located at 058DH, is CALLED from 003BH. This routine locates the printer at 37E8H, and checks its ready status by reading 37E8H for a 30H.

This routine is very poor because it is not useful with many printers other than Centronic's. (Radio Shack has assumed that a smart printer will be used.)

You can capture the routine and use your own by changing the address stored at 4026H and 4027H to the address of your printer driver. (Note: Be sure to PROTECT your printer driver program by answering the MEMORY SIZE question.)

SCANKE scans the keyboard for an entry (key closure) and returns the ASCII value of the key in the 'A' register. SKANKE is located at 002BH, you must exchange registers before calling this routine.

```
EXX ;save registers
CALL 002BH ;scan the keyboard
EXX ;restore registers
AND 7FH ;mask out bit 8
```

Cursor control table is located from 0506H to 0540H.

1. Backspace and delete character—04CEH.
2. Delete last character—04CE. HL point to video memory of character.
3. Cursor on—04B8H
4. Cursor off—04BDH
5. Convert to expanded characters—04F6H
6. Backspace cursor—04DAH
- 6a. Advance cursor—04ECH
7. Down feed cursor—04E7H
8. Up feed cursor—04F1H
9. Cursor home—04C0H
10. Cursor to beginning of line—04A1H
11. Erase from cursor to end of line—0573H

12. Clear all after cursor—057CH

Relocated to RAM on power up:

1. Vectors for interrupts—06D2 to 06E6H
2. Keyboard device control block—06E7-06EE
3. Video DCB—06EF to 06F6H
4. Printer DCB—06F7 to 06FEH
5. 4080 to 191CH (uncertain)

Basic command table—1650 to 181FH

(Note: This is ASCII text, however, the first character in a word has the most significant bit (8) set to indicate new word.)

Jump table—1820H to 18C9H. These are two word address, i.e., AE 1D means that the routine is located at 1DAEH. This table is a one for correspondence for the BASIC command table.

Error messages—18C9 to 18F6H. The data here is ASCII code and two words each, i.e., 4E 46 is the ASCII for the NF code.

If any of you readers have uncovered any more of the secrets and would like to share them, then please send addresses of the routines and any other information you have.

One last note, Radio Shack's RS-232 card has several locations for its addressing. The control of the Baud rate, parity, number of bits to be sent, etc., are a combination of both hardware and software selection. Its data port is located at port EBH.

I wish to express my thanks to Bob Coble, Dwane Saylor and Geogre Higson for their assistance in locating and defining the routines. ■

The intricacies of PRINT statements.

Variations On A Theme

George R. Bullitt
Route 82
East Haddam, CT 06423

Since becoming hooked on the TRS-80 in July 1978, it has been my singular objective to collect all the available reference material I could find on programming that wonderful machine. At best the collected works cover the more obvious routines, ignoring what I consider to be the fundamentals that can change a good program into a better one.

Printing a Line

One of those fundamentals is the printing of a line. Have you ever found in a book even one paragraph on the printing of a simple line?

Well, turn on your set, because here it is! Get yourself into BASIC, type and RUN the following:

```
10 CLEAR 100
20 PRINT STRING$(63,"-")
```

How about that!

Let's analyze the code. Line 10 clears string space.(Delete line 10 and see what happens.) Line 20 utilizes strings which

print almost anything, as many times as you want. In this instance it printed 63 dashes (-) which is the maximum for the TRS-80 screen. Just remember that the number is placed left of the comma, and the character you want printed is on the right side, enclosed in quotes (except for control codes).

Type and RUN this mini program:

```
10 CLEAR 100
20 PRINT STRING$(21,"X");STRING$(21,"");STRING$(21,"")
```

See what I mean about the STRING\$ function?

In case you have forgotten, the semicolon between statements prints everything on the same line and eliminates the need to repeat the PRINT statement for each command. On the other hand, typing a colon between statements, followed by PRINT, prints each statement on a different line. If you are a skeptic try it by retyping line 20 to read:

```
20:PRINT STRING$(21,"X");PRINT
STRING$(21,"");PRINT STRING$(21,"")
```

Okay, now that you know how to print a line, let's get more specific and print a line at the

top of the screen then another one 1/2 inch below it. Type and RUN:

```
10 CLEAR 100
20 L$ = STRING$(63,"-")
30 PRINT L$
40 PRINT CHR$(138)
50 PRINT L$
```

In spite of those funny looking bar graph lines, it works! CHR\$(138) is the ASCII code instructing the computer to print three blank lines. It also happens to be the graphics code to print that up and down bar on the screen. However, when that code is sent to a printer it prints only the three blank lines.

If you write a program strictly for the video display use the PRINT statement to print blank lines instead of CHR\$(138). If you include a routine that also writes to a printer, then use it in that part of the program to save time and memory.

Notice in line 20 that STRING\$(63,"-") is made equal to a smaller string character (L\$) again saving time and memory.

It was stated earlier that the STRING\$ function prints almost anything, so why not a control code such as CHR\$(138)? Retype line 40 to read:

```
40 PRINT STRING$(1,CHR$(138))
```

Remember, since we are using a control code, the quotes are not used to the right of the comma. Run the program and you will find that it does the same job, printing three blank lines. Each additional increase in the number to the left of the comma will print one more line and add 5/32 of an inch between the printed lines.

Changing the number to two will print four lines or 5/8 of an inch and changing it to four will print six lines or approximately 1 inch between lines and so on.

More Sophistication

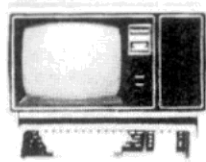
To expand the theme and make our program more sophisticated, type and run:

```
10 CLEAR 100
20 L$ = STRING$(63,"-")
30 INPUT "NO. OF LINES TO PRINT":L
40 FOR X = 1 TO L
50 PRINT L$
60 NEXT X
```

Lines 40 through 60 set up the FOR-NEXT loop, ending it when the number of lines you entered have been printed. Entering 14 fills up the screen. Seven fills half the screen. This type of program is especially useful for making up ruled lines on a page with your printer. If

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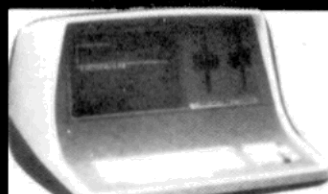
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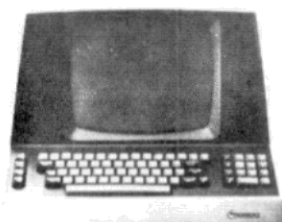


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you want to double space the lines change line 50 to read:

50 PRINT L\$: PRINT

An easier way, however, is to increase the number in line 20 from 63 to 64. Increasing the number adds a dash (-), which pushes the invisible cursor around the corner to the head of the next line, completing the command. Then it moves to the line below, creating the double space, to wait for another command, which in this case is to print 64 dashes.

Now, how about printing a line at the top of the screen and then another one two inches below it with a message in between. Type and RUN:

```
10 CLEAR 100
20 L$ = STRING$(63," ")
30 N$ = STRING$(4,CHR$(138))
40 PRINT L$
50 PRINT N$
60 PRINT TAB
(22);"REPORT TO THE BOARD"
```

70 PRINT N\$
80 PRINT L\$

Not bad! But what if I want to vary the report heading? In that case, add the following:

```
35 INPUT "TYPE IN YOUR REPORT HEADING";R$
```

Since the number of letters in the report heading will vary, a formula has to be built into the program so that the computer can figure the correct tab position, regardless of the number of letters.

The way we arrived at the tab position (22) in line 60 was to subtract the number of letters in our heading (19) from the total number of spaces (63) dividing the answer by two. Translating that into a formula the computer will understand is relatively easy. Simply stated the formula is: 63 minus the length (LEN) of the heading (R\$) divided by two (/2).

In computerese it is written

63-LEN(R\$)/2. Since the computer has to calculate the value of 63-LEN(R\$), before it can divide the answer by two, it must be enclosed in brackets.

Now the formula looks like this: (63-LEN(R\$))/2. It follows that the answer will be our final tab position. The formula itself will have to be enclosed in brackets. Retype line 60 and RUN:

```
60 PRINT TAB ((63-LEN(R$))/2);R$
```

For the finale, use the same formula to print a line across the screen with the report heading embedded in the middle. Type and RUN (clear the previous program by typing NEW and press ENTER):

```
10 CLEAR 100
20 INPUT "TYPE IN YOUR REPORT HEADING";R$
30 L$ = STRING$(63-LEN(R$))/2," "
40 PRINT L$;R$;L$
```

Simple but effective!

Note that the formula is placed to the left of the comma in line 30, giving the computer the same information as in line 60. However, instead of printing blank spaces to reach the tab position, it prints dashes (-).

To leave a blank space on either side of the report heading change lines 30 and 40 adding line 35:

```
30 L$ = STRING$(63-LEN(R$))/2-1," "
35 B$ = STRING$(1," ")
40 PRINT L$;B$;R$;B$;L$
```

In order to leave room for a blank space, one dash is subtracted from the formula in line 30, and STRING\$(1," ") is added to print that blank space on either side of the heading.

If you would like to do the exercises in this article on your printer change all PRINT statements to LPRINT. Also, you can change the number 63 to the number of characters (columns) your printer is capable of printing across the page. ■

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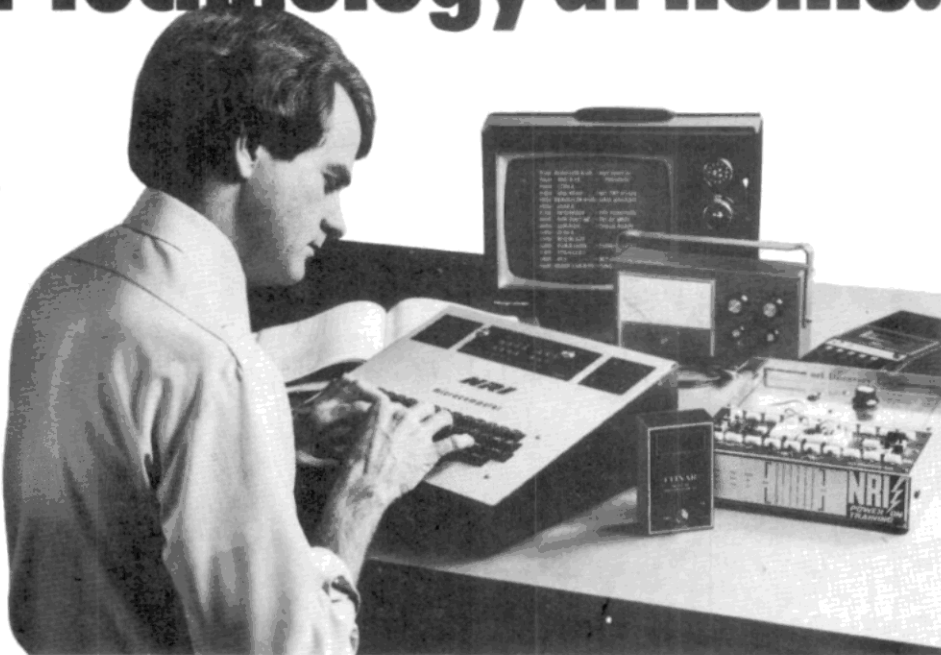
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A sort program with options plus.

Beyond Shell Metzner

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I needed a BASIC sort utility for my TRS-80, and not wanting to reinvent the wheel, I reviewed available literature in the hopes of finding a printed utility that met my business needs. I went

looking—without success—for a utility that could perform user-specified major to minor field sorts in ascending or descending order on alphanumeric or numeric fields.

I did learn that the Shell-Metzner sort algorithm provides the fastest average BASIC sorting benchmarks.

Also, records can be rearranged by swapping or by using record pointers in a separate array or within a field of a multiple dimension array that is being sorted. In general, pointers

allow faster BASIC sort speeds than record swapping, but more computer memory is needed to hold them and the expanded BASIC coding.

Both alphanumeric and numeric sorts can be readily accommodated, if a character string array holds the file to be sorted. The BASIC VAL function is used for numeric field sorts.

If the record swapping method is used, it is much faster to use the BASIC VARPTR function to swap character string field addresses than to ex-

change field values. This approach minimizes time consuming string space reallocations.

Develop Your Own Sort

Armed with these ideas, I developed a Level II, BASIC sort utility of my own.

Within a two-dimensional array, it allows you to specify an unlimited number of sort fields in major to minor sort sequence. You can also specify whether the sort on each field is to be ascending or descending, and whether numeric or alphanumeric.

The user specifies the sort parameters through INPUT and INKEY\$ statements; but the program can be modified easily to assign the parameters for your business application program and then branch to the BASIC sort utility.

Program Listing 1 contains the BASIC program. Lines 140 through 250 are not part of the sort utility, but generate random character string data that is input for demonstration sorts.

Lines 260 through 480 prompt the user to input the sort parameters. Notice that the single dimension array A\$() contains the data field names. Lines 500 through 660 contain the coding

```

ENTER AMOUNT OF STRING SPACE TO RESERVE? 2000
ENTER NUMBER OF RECORDS TO GENERATE? 5
BNBQMOQ      82      M      97055
NT            18      F      97052
DD            69      F      97054
TMOGGZS      51      M      97051
QTFMRZTX     61      F      97054
ENTER NAME SORT FIELD 1 ('NAME', 'AGE', 'SEX', OR 'ZIP CODE') OR
ENTER 'STOP'? SEX
IS THE FIELD NUMERIC (Y/N)?N
ASCENDING OR DESCENDING SORT (A/D)?A
ENTER NAME SORT FIELD 2 ('NAME', 'AGE', 'SEX', OR 'ZIP CODE') OR
ENTER 'STOP'? AGE
IS THE FIELD NUMERIC (Y/N)?Y
ASCENDING OR DESCENDING SORT (A/D)?D
ENTER NAME SORT FIELD 3 ('NAME', 'AGE', 'SEX', OR 'ZIP CODE') OR
ENTER 'STOP'? STOP
DD            69      F      97054
QTFMRZTX     61      F      97054
NT            18      F      97052
BNBQMOQ      82      M      97055
TMOGGZS      51      M      97051

```

Example 1. A Sample Run

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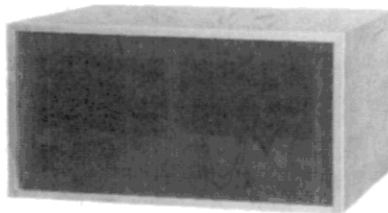
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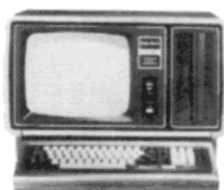
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for the sorts.

The Shell-Metzner sort algorithm¹ has been used with a subroutine in lines 930 through 1010. Using the VARPTR, this subroutine compares sort field values (that switch record address pointers) in line 1030 through 1090.² Notice in the sort field value comparison that VAL is used to perform numeric sorts. The relational operators ">" and "<" are used for ascending and descending sorts.

Lines 680 through 690 check to see if there is another sort field. If not, the sort is completed and lines 850 through 870 display the sorted records.

If there is another sort field, lines 710 through 830 identify ranges of records in the prior sort which are equal to those in the second field. The beginning and ending record numbers of the previous sort field ranges, which equal the ranges in the second field, are input to the Shell-Metzner algorithm. These records are then re-sorted to the current field specifications.

Line 560 ignores record comparisons that are outside the current range of interest. This process is repeated until all records are processed.

A Sample Run

Example 1 is a sample run of

Sort Sequence	Field Name	Sort Order	Data Type
Major	Sex	Ascending	Alphanumeric
Minor	Age	Descending	Numeric

Program Listing 1

five records generated by random field values. Next, a sort is specified in the order shown in Table 1.

Finally, the sorted records are displayed. Note that all "F" sex field records are ordered before

on the minor sort field).

This BASIC sort has proved reliable and a real time-saver when writing business programs. Hopefully, you will be able to put it to good use with your system. ■

1. Thomas E. Doyle, *Kilobaud Microcomputing*, "5 Minutes Or 5 Hours—Sorting Routines Compared," May 1978, pages 100-102.

2. T. R. Dettman, *80-US Journal*, "Super Sorting," November/December 1979, pages 28 and 62.

all "M" sex field records (ascending sort sequence on major sort field). Within "F" and "M" ages are ordered from oldest to youngest (descending sort order

```

10 REM * USER DEFINED MULTIPLE FIELD SORTS *
20 REM * * * ASCENDING OR DESCENDING *
30 REM * * * ALPHANUMERIC OR NUMERIC *
40 REM * * * MAJOR TO MINOR *
50 REM      DOUG WALKER
60 REM      3485 MOCK ORANGE COURT SOUTH
70 REM      SALEM, OREGON 97303
80 REM      (503) 393-2685
90 REM * HOUSEKEEPING *
100 CLS:DEFINT A-Z
110 INPUT"ENTER AMOUNT OF STRING SPACE TO RESERVE";D
120 CLEAR D
130 REM * GENERATE RANDOM SORT RECORDS *
140 INPUT"ENTER NUMBER OF RECORDS TO GENERATE";A
150 DIM C$(A,4),A$(4):A$(1)="NAME":A$(2)="AGE":A$(3)="S
    EX":A$(4)="ZIP CODE"
160 FOR I=1 TO A
170 B=RND(8)
180 FOR C=1 TO B
190 C$(I,1)=C$(I,1)+CHR$(RND(26)+64)
200 NEXT C
210 E=RND(85):C$(I,2)=STR$(E)
220 IF RND(2)=1 THEN C$(I,3)="M" ELSE C$(I,3)="F"
230 E=97050 + RND(5):C$(I,4)=STR$(E)
240 PRINT C$(I,1),C$(I,2),C$(I,3),C$(I,4)
250 NEXT I
260 REM * USER SPECIFIES SORT PARAMETERS *
270 FOR C=1 TO 4:C1(C)=-1:C2(C)=0:D(C)=0:NEXT C
280 R=1:J=A:K=1
290 PRINT"ENTER NAME SORT FIELD";R;INPUT"('NAME', 'AGE
    ', 'SEX', OR 'ZIP CODE') OR ENTER 'STOP'";S$
300 IF S$="STOP" AND R=1 GOTO290
310 IF S$="STOP" GOTO480
320 FOR C=1 TO 4
330 IF S$=A$(C) GOTO360
340 NEXT C
350 GOTO290
360 C1(R)=C
370 PRINT"IS THE FIELD NUMERIC (Y/N)?"
380 GOSUB1100
390 S1$=CH$
400 IF S1$="Y" THEN C2(R)=1:GOTO420
410 C2(R)=2
420 PRINT"ASCENDING OR DESCENDING SORT (A/D)?"
430 K$=INKEY$:IF K$="" GOTO430 ELSE PRINT K$
440 IF K$="A" THEN D(R)=1:GOTO460
450 IF K$="D" THEN D(R)=2 ELSE GOTO420
460 IF R=4 GOTO480
470 R=R+1:GOTO290
480 Z6=1
490 REM * SORTS USING SHELL METZNER ALGORITHM **
500 Z3=J
510 Z3=INT(Z3/2)
520 IF Z3=0 THEN G50
530 Z4=K:Z5=J-Z3
540 Z7=Z4
550 Z8=Z7+Z3
560 IF Z6>1 AND (Z7<K OR Z7>J OR Z8<K OR Z8>J) THEN G60
570 GOSUB920
580 IF F1=2 GOTO620 ELSE GOSUB1020
590 Z7=Z7-Z3
600 IF Z7<1 THEN G620
610 GOTO550
620 Z4=Z4+1
630 IF Z4>Z5 THEN G510
640 GOTO540
650 IF Z6=1 THEN G680
660 IF Z6>1 AND M=A THEN G680 ELSE G720
670 REM * SEE IF THERE IS ANOTHER FIELD TO SORT *
680 Z6=Z6+1
690 IF C1(Z6)=-1 THEN G840
700 REM * SORT SEGMENT COMPUTATION ON INTERMEDIATE TH
    RU MINOR FIELD SORTS *
710 M=1
720 Z7=M:Z8=M+1:J=1:L=0
730 IF C2(Z6-1)=1 THEN G760
740 IF C$(Z7,C1(Z6-1))=C$(Z8,C1(Z6-1)) THEN J=J+1 ELSE
    L=1
750 GOTO770
760 IF VAL(C$(Z7,C1(Z6-1)))=VAL(C$(Z8,C1(Z6-1))) THEN J
    =J+1 ELSE L=1
770 IF L=0 THEN G800
780 IF L=1 AND J>1 THEN K=M:J=Z7:M=Z8:GOTO500
790 L=0:M=Z8
800 Z7=Z7+1:Z8=Z8+1
810 IF Z7<A THEN G730
820 IF L=0 THEN K=M:M=Z7:J=Z7:GOTO500
830 GOTO680
840 REM * DISPLAY SORTED RECORDS *
850 FOR I=1 TO A
860 PRINT C$(I,1),C$(I,2),C$(I,3),C$(I,4)
870 NEXT I
880 REM * CONTINUATION CHECK *
890 PRINT"DO YOU WANT TO SORT THESE RECORDS AGAIN (Y/N)
    ?";
900 GOSUB1100
910 IF CH$="Y" THEN G270 ELSE END
920 REM * RECORD ADDRESS POINTER SWITCH CHECK *
930 IF D(Z6)=2 GOTO970
940 IF C2(Z6)=1 GOTO960
950 IF C$(Z7,C1(Z6))<C$(Z8,C1(Z6)) THEN 1000 ELSE 1010
960 IF VAL(C$(Z7,C1(Z6)))<VAL(C$(Z8,C1(Z6))) THEN 1000
    ELSE 1010
970 IF C2(Z6)=1 THEN G90
980 IF C$(Z7,C1(Z6))>C$(Z8,C1(Z6)) THEN 1000 ELSE 1010
990 IF VAL(C$(Z7,C1(Z6)))>VAL(C$(Z8,C1(Z6))) THEN 1000
    ELSE 1010
1000 F1=2:RETURN
1010 F1=1:RETURN
1020 REM * RECORD ADDRESS POINTER SWITCH *
1030 FOR C=1 TO 4
1040 I1=PEEK(VARPTR(C$(Z7,C))) : I2=PEEK(VARPTR(C$(Z7,C)
    +1)) : I3=PEEK(VARPTR(C$(Z7,C)+2))
1050 J1=PEEK(VARPTR(C$(Z8,C))) : J2=PEEK(VARPTR(C$(Z8,C)
    +1)) : J3=PEEK(VARPTR(C$(Z8,C)+2))
1060 POKE(VARPTR(C$(Z7,C)),J1):POKE(VARPTR(C$(Z7,C)+1)
    ,J2):POKE(VARPTR(C$(Z7,C)+2),J3)
1070 POKE(VARPTR(C$(Z8,C)),I1):POKE(VARPTR(C$(Z8,C)+1)
    ,I2):POKE(VARPTR(C$(Z8,C)+2),I3)
1080 NEXT C
1090 RETURN
1100 REM * Y/N INPUT CHECK *
1110 CH$=INKEY$:IF CH$="" THEN 1110
1120 IF CH$="N" OR CH$="Y" THEN PRINT CH$:RETURN ELSE 1
    110

```

Table 1

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tests RAM above hexadecimal F300, its own starting address. The Debug Monitor displays and modifies the user area between hexadecimal 2800 and F2FF only.

In order to gain access to the entire RAM, one must either write an independent debug program or disable the memory protection system of the TRSDOS Debug Monitor. The latter may be accomplished with the procedure described in this communication.

Memory Protection System

Five debug commands (ra(M), (B)rk, (J)ump, (L)oad and (F)ind share an address-entry subroutine from hexadecimal F9C0 to FA19 which contains a protection segment (Table 1). The simplest way to disable this segment is to load 00 (NOP) into hexadecimal addresses FA01 to FA06 and 80FF into FA09-FA0A.

Unlike ROM-based operating systems, the TRS-80 Model II operating system (TRSDOS version 1.2) is loaded from disk into internal memory on power up. Since the supervisor program and input/output drivers always reside in the lower 7K of RAM, this software should be easily accessible for inspection or temporary modification.

The TRSDOS Debug Monitor, however, is programmed to conceal memory locations below hexadecimal 2800. It also pro-

Address	Object Code	Instruction	Comments
2800	21 01 28	LD HL,2801	
2803	E5	PUSH HL	LOAD STACK FOR RETURN
2804	3E 00	LD A,0	CLEAR ACCUMULATOR
2806	21 01 FA	LD HL,FA01	ADDRESS OF PROTECT IN DEBUG
2809	77	LD (HL),A	CLEAR MEMORY 'FA01'
280A	23	INC HL	
280B	77	LD (HL),A	CLEAR MEMORY 'FA02'
280C	23	INC HL	
280D	77	LD (HL),A	CLEAR MEMORY 'FA03'
280E	23	INC HL	
280F	77	LD (HL),A	CLEAR MEMORY 'FA04'
2810	23	INC HL	
2811	77	LD (HL),A	CLEAR MEMORY 'FA05'
2812	23	INC HL	
2813	77	LD (HL),A	CLEAR MEMORY 'FA06'
2814	23	INC HL	
2815	23	INC HL	
2816	23	INC HL	
2817	36 80	LD (HL),80	PUT '80' IN 'FA09'
2819	23	INC HL	
281A	36 FF	LD (HL),FF	PUT 'FF' IN 'FA0A'
281C	21 A5 F6	LD HL,F6A5	STEPMODE PROTECTION ADDR.
281F	36 FF	LD (HL),FF	PUT 'FF' IN 'F6A5'
2821	C3 77F3	JP F377	ENTER DEBUG MONITOR

Table 2

The step-mode loader (ra(M)) has a protection segment at hexadecimal F6A3 to F6AC which may be disabled by loading FF into address F6A5.

There are two protection segments which should not be disabled. These are at F4A0 for (L)oad (TOP) and F930 - F93D for (U)pload.

The program in Table 2 makes the proper changes to disable the protection segments. It is written in linear fashion for simplicity, but a loop may be substituted for the repetitive sequence. Implement it as follows:

1. In TRSDOS READY mode,

type DEBUG ON and press ENTER.

2. TRSDOS READY will return. Then type DEBUG and press ENTER.

3. RAM from 2800 will be displayed. To enter ra(M) command, press M.

4. The prompt A = will appear. To modify RAM, press the F1 key.

5. Now enter the object code program from Table 2.

6. To effect this change in memory, press the F2 key.

7. To execute the program press C.

The monitor will then access

Address	Object Code	Instruction	Comments
F9FF	AF	XOR A	CLEAR ACCUMULATOR
FA00	21 FF 27	LD HL,27FF	LOWER LIMIT OF USER AREA
FA03	ED 52	SBC HL,DE	DE CONTAINS THE SELECTED ADDR.
FA05	30 CD	JR NC,disp	IF DE<HL DO NOT CONTINUE
FA07	AF	XOR A	CLEAR ACCUMULATOR
FA08	21 FF F2	LD HL,F2FF	UPPER LIMIT OF USER AREA
FA0B	ED 52	SBC HL,DE	DE STILL CONTAINS SELECTED ADDR.
FA0D	38 C5	JR C,disp	IF DE>HL DO NOT CONTINUE

Table 1

any area of RAM desired. The modified debug program may be saved on disk with the following steps.

8. To return to TRSDOS press S.

9. In TRSDOS READY mode type DUMP BUGGY (START=F300, END=FF80, TRA=3000) and press ENTER.

Now the command BUGGY may be used in place of DEBUG after DEBUG ON. The command DEBUG ON sets the proper calling parameters in the supervisor area, and the command BUGGY loads the modified program in high RAM. BUGGY will not run if DEBUG is OFF.

With BUGGY the entire RAM is available for inspection. The user who wants to study the architecture of TRDOS should first become familiar with the Debug Monitor. The debug program is a good introduction to supervisor calls (SVCs) and interaction with the operating system. Important addresses are listed in Table 3.

TRSDOS consists of a set of

supervisor functions which reside in RAM and an overlay system which loads auxiliary code into a specified area as needed. Many of the supervisor functions can be called from user programs using RST 8 (SVCs).

The SVC calling segment is located between hexadecimal 0145 and 018A. Because the Debug Monitor uses an SVC to set breakpoints, the monitor command (B)rk cannot be executed in the SVC calling routine itself. The address table for the SVCs starts at hexadecimal 01A2 (Table 4). The stack pointer starts at 1F00, and the overlay area is above 2000.

Conclusion

Model II TRSDOS (version 1.2) is a versatile and powerful disk operating system which appears to be relatively free of errors. Since the system is user-oriented, most users (such as businesses and schools) will not require direct access to the operating system itself.

Computer hobbyists and systems' programmers, however, will benefit from easy access to the TRSDOS machine code (especially the supervisor func-

tions). Until independent debuggers and disassemblers become available for the Model II, the TRSDOS Debug Monitor can be used. ■

START ADDR	FUNCTION or OPERATION	START ADDR	FUNCTION or OPERATION
F300	Initialization	F467	(L)oad Command Routine
F377	Program Entry Semgnet	F487	(P)rint Command Routine
F386	Main Command Mode Routine	F4D2	(E)mpty Command Routine
F422	(D)ecimal Command Routine	F4EE	(F)ind Command Routine
F429	he(x) Command Routine	F562	(B)rk Command Routine
F430	(J)ump Command Routine	F5Df	(C)ontinue Command Routine
F43F	(O)ut Command Routine	F7C7	ra(M) Command Routine
F445	(H)elp Command Routine	F8A5	(R)egister Command Routine
F457	(S)ystem Command Routine	F8A5	(U)pload Command Routine

Table 3

SVC NAME	START ADDR	SVC NAME	START ADDR	SVC NAME	START ADDR	SVC NAME	START ADDR
0 INITIO	02A2	11 VDREAD	084B	25 TIMER	0342	41 KILL	13EF
1 KINIT	037A	12 VIDKEY	094D	26 CURSOR	060D	42 CLOSE	13F5
2 SETUSR	0518	15 DISKID	0EA3	27 SCROLL	09AA	43 WRITNX	1809
3 SETBRK	04E6	17 PRINT	0EEA	33 LOCATE	1896	44 DIRWR	182C
4 KBCAR	039A	18 PRCHAR	0F44	34 READNX	172F	45 DATE	1C09
5 KBLINE	030B	19 PRLINE	0F25	35 DIRRD	1746	48 PARSE	1201
6 DELAY	08B7	20 RANDOM	09E6	36 JP2DOS	1237	49 STSCAN	1CC6
7 VDINIT	0560	21 BINDEC	0A35	37 DOSCMD	1388	52 ERRMSG	139D
8 VDCHAR	063D	22 STCMP	09D3	38 RETCMD	138D	55 RS232C	1408
9 VDLINE	092C	23 MPYDIV	0ABD	39 ERROR	13A6		
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Table 4

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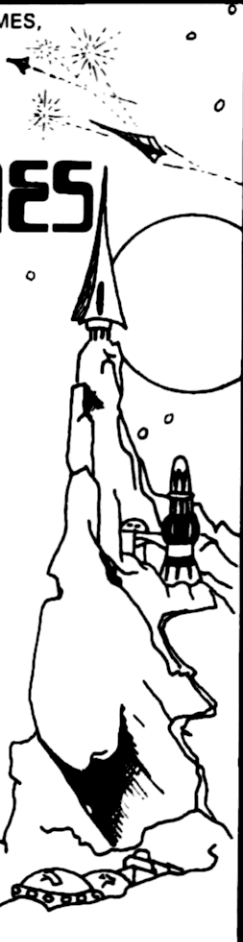
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- Sort files one disk in length
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 - input/output record size
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 - print contents of output file
 - input/output file key specifiers

The minimum requirement is a 32K TRS-80* Level II computer with one disk drive or a single drive Model II computer. It will operate on 35, 40 and 77 track drives, and has been tested on TRSDOS 2.1, 2.2, 2.3, NEWDOS 2.1, 3.0, and VTOS 3.0.1. It is compatible with most machine language printer drivers. Sort time is fast; for example, a 32K file will sort in approximately 40 seconds. **\$59.**

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This menu driven system provides the TRS-80* user with a computerized method to keep track of all programs and data files. The idea is to build and maintain on a file a disk detailing each program including program name, size, creation date, and a brief narrative as to function. Programs are provided to:

- create, update, or display
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- print file listing
- create a file automatically

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InfoBox is the easiest-to-use information manager available for the TRS-80*. It's ideal for keeping track of notes to yourself, phone numbers, birthdays, inventories, bibliographies, computer programs, music tapes, and much more. This fast assembly language program lets you enter free-format data, variable length items and lets you look up items by specifying a string of characters or words that you want to find. You can also edit and delete items. Items entered into InfoBox can be written to and read from cassette and disk files. All or selected items can be printed on a parallel or serial printer. InfoBox occupies 3K. Specify cassette or disk version. Special introductory price **\$24.95** until June 15; **\$29.95** after.

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File Management System by SBSG

This menu driven program allows you to define and create files for your own use. You can:

- sort these files in:
 - ascending order
 - descending order
 - on up to 3 separate fields
- scan the files
- summarize any numeric or dollar data fields
- print the field records
- create, add to or delete field records

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Slow Scroll

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Having converted from Level I to Level II, I am extremely pleased with all the new features of the more advanced language. One wrinkle that I don't appreciate, however, is the way the program files by on the

screen when you list it. In this regard, Level I has a superior system by stopping the list when the screen is almost full and allowing you to hit the up arrow key to move the display up the screen.

I know you can press Shift @ to freeze the display, but I am invariably fumble-fingered and find that the part of the program that I wanted to see has somehow whisked by before I could stop it.

Another thing that bothers me

about automatic scrolling is that whenever I write a program that displays more than one screen full of data, I need a "Press Enter to Continue" routine to stop the display.

There are three things I don't like about that procedure. First, you have to keep track of the lines that your program is displaying so you know where to insert the pauses. Second, you cannot use the bottom line of the screen because it is needed for the "PRESS ENTER..." message. Third, if the user has the option to output to the printer, your program has to bypass the pause messages in that case.

A small modification to the Level II video driver solves all of the above. With this modification installed, any line that ends with a new line character (ASCII 13), normally causing the screen to scroll, now has the following effect:

- The display freezes after that line is printed.

- Pressing the up arrow allows normal printing to continue until the next new line character (just like Level I LIST).

- Pressing CLEAR clears the screen and a new screen of data is displayed.

- Pressing Break stops the program or the list and the ready

message is displayed.

- Any other key is ignored.

The modification is not active when the cursor is turned on. This allows the screen to scroll normally when you are inputting a long program. You can also use this feature to temporarily turn off the modification within a program. By executing a PRINT CHR\$(14) the cursor is turned on and normal scrolling is in effect until you turn it off with a PRINT CHR\$(15).

The cursor will also be turned off after an INPUT statement or if the program is restarted from Ready.

Three Methods

You can load the modification in three ways. With any method, the program is completely relocatable. My version ends at the top of a 16K machine, you may want to load it at a different location to accommodate a larger memory size or other machine language routines.

If you have the Editor/Assembler, enter the source code shown in Program Listing 1, assemble it and create a SYSTEM tape. Then initialize the system by entering SYSTEM followed by /0 and set memory size to 32678. Load the SYSTEM tape and enter a / to execute it. Enter CLEAR, and you're in business.

Program Listing 1. Source Code

```

00100 ; SCREEN CONTROL - 11/85/79 - PETER A. LEWIS
00120 ;
00140 ; SET UP DCB DRIVER ADDRESS
00160 ;
00180 ;
00200 INIT ORG 32679
00220 CALL 000BH ;PUT LOCN IN HL
00240 LD DE,SCREEN-5
00260 ADD HL,DE
00280 LD (401EH),HL ;ENTRY ADDR TO DCB
00300 JP 06CCH ;RETURN TO READY
00320 ;
00340 ; CHECK FOR FLAG CHARACTER (0BH = OFF, 01H = ON)
00360 ;
00380 SCREEN PUSH AF ;SAVE FLAGS
00400 CALL 000BH ;PUT LOCN IN HL
00420 JR BYPFLG ;BYPASS FLAG
00440 DEFB 0 ;ON/OFF FLAG
00460 BYPFLG INC HL ;HL POINTS TO FLAG
00480 INC HL
00500 LD A,C ;CHARACTER TO A
00520 AND 0FEH ;LOW BIT OFF
00540 JR NZ,NOFLAG ;NOT A FLAG
00560 ;
00580 ; SAVE NEW FLAG
00600 ;
00620 LD (HL),C ;STORE NEW FLAG
00640 JR BYPDRV ;BYPASS DRIVER
00660 ;
00680 ; TEST FLAG
00700 NOFLAG LD A,(HL) ;FLAG TO A
00720 OR A ;TEST FOR ZERO
00740 JR Z,RSTRA ;ZERO - BYPASS ROUTINE
00760 ;

```

Program continues.

```

00700 ; TRAP NEW LINE CHARACTER
00800 ;
7FC9 3A2240 00820 LD A,(4022H) ;CURSOR CHAR
7FCC B7 00840 OR A ;IS CURSOR ON?
7FCD 2025 00860 JR NZ,RSTRA ;YES - GO TO DRIVER
7FCF 79 00880 LD A,C ;CHARACTER TO A
7FD0 FE0D 00900 CP 0DH ;NEW LINE?
7FD2 2020 00920 JR NZ,RSTRA ;NO - TO DRIVER
7FD4 2A2040 00940 LD HL,(4020H) ;CURSOR ADDR
7FD7 114900 00960 LD DE,40H ;LINE SIZE
7FDA 19 00980 ADD HL,DE ;ADD 1 LINE
7FDB 7C 01000 LD A,H ;NEW MSB
7FDC FE40 01020 CP 40H ;SCREEN OVERFLOW?
7FDE 2014 01040 JR NZ,RSTRA ;NO - TO DRIVER
01060 ;
01080 ; WAIT FOR KEYBOARD ENTRY
01100 ;
7FE0 CD4900 01120 KBDIN CALL 49H ;WAIT FOR KEYBD
7FE3 FE01 01140 CP 01H ;BREAK?
7FE5 2011 01160 JR Z,READY ;YES - SEND READY
7FE7 FE5B 01180 CP 5BH ;UP ARROW?
7FE9 2009 01200 JR NZ,RSTRA ;YES - TO DRIVER
7FEB FE1F 01220 CP 1FH ;CLEAR?
7FED 20F1 01240 JR NZ,KBDIN ;NO - READ KEYBD AGAIN
01260 ;
01280 ; PROCESS CLEAR KEY
01300 ;
7FEF CDC901 01320 CALL 01C9H ;CLEAR SCREEN
01340 ;
01360 ; BYPASS DRIVER
01380 ;
7FF2 F1 01400 BYPRV POP AF ;RESTORE FLAGS
7FF3 C9 01420 RET ;BYPASS DRIVER
01440 ;
01460 ; RETURN TO DRIVER
01480 ;
7FF4 F1 01500 RSTRA POP AF ;RESTORE FLAGS
7FF5 C35004 01520 JP 0450H ;TO DRIVER
01540 ;
01560 ; RETURN TO READY
01580 ;
7FF8 300E 01600 READY LD A,0EH ;TURN ON CURSOR
7FFA 322240 01620 LD HL,(4022H) ;A
7FFD C3191A 01640 JP 1A19H ;TO READY MSG
7FA7 01660 END INIT
00800 TOTAL ERRORS

BYPRV 7FF2 01400 00620
BYPLG 7FB5 00440 00400
INIT 7FA7 00200 01660
KBDIN 7FE0 01120 01240
NOFLAG 7FC5 00700 00520
READY 7FF8 01600 01160
RSTRA 7FF4 01500 00740 00660 00920 01040 01200
SCREEN 7FB4 00360 00220

```

```

100 REM - SCREEN CONTROL - 11/8/79 - PETER A. LEWIS
120 DEFINT A-Z
140 CLS:INPUT "ENTER STARTING ADDRESS FOR LOAD";A
160 IF A=0 THEN A=32679
180 FOR X=0 TO 88
200 READ D
220 POKE A+X,D
240 NEXT X
260 PRINT "TO ACTIVATE, ENTER:"
280 PRINT:PRINT,"SYSTEM":PRINT,"/";A:PRINT,"CLEAR":PRI
NT
300 PRINT "PRINT CHR$(1) TO TURN ON, PRINT CHR$(0) TO T
URN OFF"
320 PRINT
340 END
1000 DATA 205,11,0,17,10,0,25,34,30,64,195,25,26,245
1020 DATA 205,11,0,24,1,0,35,35,121,230,254,32,3,113
1040 DATA 24,45,126,183,40,43,58,34,64,183,32,37,121
1060 DATA 254,13,32,32,42,32,64,17,64,0,25,124,254,64
1080 DATA 32,20,205,73,0,254,1,40,17,254,91,40,9,254
1100 DATA 31,32,241,205,201,1,241,201,241,195,88,4,62
1120 DATA 14,50,34,64,195,25,26

```

Program Listing 2. BASIC

If you want the program to be loaded at a different location in memory, just change the ORG statement. Remember to set memory size to one less than that address.

If you have T-BUG, you can enter the object code shown on the left side of Listing 1 by using the M command. Then use the P command to create a SYSTEM

tape.

The third method of loading is the BASIC program shown in Program Listing 2. This routine allows you to specify the load address. (Entering 0 loads the program at the top of 16K.)

The modification can be turned on or off by executing a PRINT CHR\$(1) or PRINT CHR\$(0), respectively. ■

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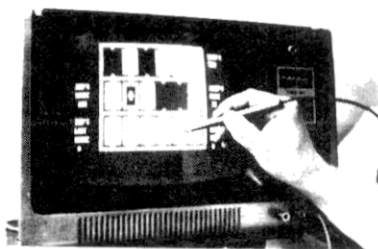
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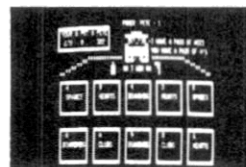
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Halve track access time with a software patch.

QWIKDISK

Bruce Nazarian, WD8DRK
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While doing my homework on the various Disk Operating Systems available for a new pair of mini-floppy disk drives I just acquired, I ran across Apparat's NEWDOS and NEWDOS+. Each looked like an improvement over the TRSDOS 2.2 I was using, so I scraped up some money and took the plunge.

NEWDOS made disk operations simpler and more reliable. But this was not to be its only benefit.

While researching NEWDOS+, I read an article by Lance Micklus describing the track-to-track access time used in TRSDOS and NEWDOS (40 ms) and how this time could be improved by a factor of two or four. After reading further, it turned out the changes involved

POKEing new values into the DOS from BASIC. The article mentioned that a patch to incorporate these changes would be available as soon as the author had time to work on it.

The Interim

In the interim, I tried everything to get QWIKDISK, as I called it, to operate efficiently.

I wrote a short BASIC program to POKE the values, but that meant I had to load BASIC, fix the access times and return to DOS.

I then tried converting the POKES into Z-80 machine language and executing the code automatically each time the DOS booted up. This was much faster than BASIC, but still not very elegant.

Then I decided to attack the problem from a different angle. Why wait? After all, the DOS is just a Z-80 machine language program, like any other machine language program. I had done much machine language programming, on 6502 as well as Z-80, so I figured, if the guy who

found the fixes could write a patch, maybe I could, too.

First of all, I used a machine language monitor program to dump portions of the DOS around the fixes. That gave me the hex machine code for the program at those points. I also dumped those same locations in ASCII for convenience.

Next, using Superzap (part of NEWDOS+) I examined the system programs on a DOS disk. Since Superzap dumps each disk sector in both hex and ASCII, I used the ASCII I had dumped beforehand to search for a character string that was identical.

Examining sector after sector, I finally hit paydirt in Sector 7. This sector is part of the module called SYS0/SYS. There it was, the identical ASCII string! Looking at the hex dump of that section, I compared it byte-for-byte to be sure I had the identical code. Then, using Superzap, I carefully replaced that one byte with its new value. Superzap wrote the sector back to disk with the new value in place.

With that sector done, I began

searching for the ASCII string identical to the second one I dumped. I found it in Sector 9. Checking against my hex dump once more, I ascertained that this was indeed the second POKE point. Again, I used Superzap to correct the value in that sector to the new one and write the sector back to disk.

Now for the acid test. Would the fixed DOS boot up correctly from disk? With some uncertainty I pressed RESET. To my delight the disk bootstrapped at normal speed, then took off like a buzzsaw when the modified program was loaded.

How to Do It

Before I explain in detail how and where to modify your DOS diskettes, a word of warning: Superzap is a very powerful utility and, if used improperly, can easily destroy the system information on your diskette. Be sure you know how to use it correctly.

In addition, this modification is for `--SYSTEM--` diskettes, i.e. DOS diskettes only. Ordinary formatted data diskettes will not have the system programs

```
000700 A847 C356 47C3 0047 C337 47C3 5F47 3E8B .G.VG..G.7G..G>.  
000710 F5CD 0046 F1CD 5846 CDF3 45E6 813D C269 ...F..XF..E..=..  
000720 463A 0943 32E1 3718 EP81 1467 44C3 CF44 F1.C2.7....D..D  
000730 C3DF 44C3 B74C C3D2 4C3E D3EF 3EE3 EP81 ..D..L..L>...  
000740 7180 444E 414D 454E 414D 452F 4558 542E ..DNAMENAME/EXT.
```

```
000700 A847 C356 47C3 0047 C337 47C3 5F47 3E8A .G.VG..G.7G..G>.  
000710 F5CD 0046 F1CD 5846 CDF3 45E6 813D C269 ...F..XF..E..=..  
000720 463A 0943 32E1 3718 EP81 1467 44C3 CF44 F1.C2.7....D..D  
000730 C3DF 44C3 B74C C3D2 4C3E D3EF 3EE3 EP81 ..D..L..L>...  
000740 7180 444E 414D 454E 414D 452F 4558 542E ..DNAMENAME/EXT.
```

Fig. 1. Partial dump of NEWDOS, Track 0, Sector 7 showing (top) byte #0F before modification and (bottom) the same byte after modification to 20 ms access time. Columns at left indicate Drive # (0), Track # (00), Sector # (7) and starting byte number of each line (00, 10, 20, etc.)

```
000900 0046 CD69 463A ED37 BAED 53EE 37C8 3E1B .F..F1:7..S.7>.  
000910 F5CD 6946 F132 EC37 C907 3005 3ED0 32EC ...F.2.7..0>..2.  
000920 37CD F345 CB47 C818 F032 9446 E3C5 4623 7..E.G...2.F..P#  
000930 7E23 32C9 467E 2366 6F22 A846 E1E3 CD47 .#2.F.#..".F...G  
000940 46CD 5544 C5D5 E521 EC37 F336 0011 EF37 F.UD...1.7.6...7
```

```
000900 0046 CD69 463A ED37 BAED 53EE 37C8 3E1A .F..F1:7..S.7>.  
000910 F5CD 6946 F132 EC37 C907 3005 3ED0 32EC ...F.2.7..0>..2.  
000920 37CD F345 CB47 C818 F032 9446 E3C5 4623 7..E.G...2.F..P#  
000930 7E23 32C9 467E 2366 6F22 A846 E1E3 CD47 .#2.F.#..".F...G  
000940 46CD 5544 C5D5 E521 EC37 F336 0011 EF37 F.UD...1.7.6...7
```

Fig. 2. Partial dump of NEWDOS, Track 0, Sector 9 showing (top) unmodified and (bottom) modified second byte of Qwikdisk modification. Same modification may be made to either 35 or 40 track versions.

```

000700 B920 042C 7E18 1871 2643 6PCD 6946 3AED .....6C...F.
000710 3777 796F 7E32 ED37 79CD 3946 3209 436F 7...2.7..9F2.C.
000720 3AEC 3707 7D32 E137 3008 2100 002B 7CB5 :.7..2.70.1..+.
000730 20FB E1C9 E607 0707 07F6 C732 4546 AFCD .....2EF..
000740 C7C9 CD00 46CD 6946 3AED 37BA ED53 EE37 ...F..F.7..S.7
000750 C83E 1AF5 CD69 46F1 32BC 37C9 CD58 46F5 >....P.2.7..XF.
000760 F100 0000 CDAC 43CB 47C8 18F8 3293 46E3 .....C.G..2.F.
000770 C546 237E 2332 D346 7E23 666F 22A7 46E1 .F0.02.F.0..F.
000780 E3CD 4746 CD69 46C5 D5E5 21BC 3736 0011 ..GP..F..1.76..
000790 EF37 C1C5 C1C5 F318 030F 300C 7ECB 4F28 .7.....0..0(O
0007A0 F8F3 0000 03C3 A146 F87E B67C 36D0 E1D1 .....F..6..
0007B0 C128 23CB 5720 13FE 2028 11F5 3E3F 3208 .(0.W...(.2.
0007C0 43CD 0046 3E0B CD58 46F1 10B5 473E 00CB C..F>..XF..G>..
0007D0 0038 033C 18F9 C1C9 3E08 CD71 460A 011A .8.<.....F..
0007E0 023E A8CD 7146 0509 0A12 3EA9 18F5 3E08 >..F.....>..
0007F0 CD71 4605 011A 0001 0542 44C3 0047 0139 ..F.....BD..G.9

```

Fig. 3. Full sector dump of TRSDOS 2.2, Track 0, Sector 7. Both bytes to be modified are present in this sector and the figure shows (top) unchanged and (bottom) changed information.

on them.

This modification further assumes that the SYS0/SYS module will be at the same location on each system diskette. If you find that the byte at the specified location is not what I have indicated, *don't change it*. First, make sure you have the right track and sector before you alter any program bytes.

For NEWDOS or NEWDOS +, the bytes to change are located in two different sectors, as described in the story above. First, modify Track #0, Sector 7, relative byte # OFH (Fig. 1).

The original value should be OBH. This gives 40 ms track access time. For 20 ms change this byte to 0AH, and for 10 ms change it to 09H.

The second location is Track

#0, Sector 9, relative byte # OFH (Fig. 2). Normally, this byte would be 1BH. For 20 ms access, change it to 1AH, and for 10 ms make it 19H.

Modifying TRSDOS 2.2

If you have TRSDOS 2.2, you will need the Superzap utility included in NEWDOS +. But, if you can acquire it your disk changes are easy.

Both of the TRSDOS changes are made in one sector. First: Track 0, Sector 7, relative byte # 52H (Fig. 3). Its 40 ms value is 1FH. Change this to 1AH for 20 ms or 19H for 10 ms. Then change relative byte #C5H. Its 40 ms value is 0BH. Change it to 0AH for 20 ms, or 09H for 10 ms. That's all there is to it. (Fig. 3).

It will save a lot of time and ef-

```

000700 B920 042C 7E18 1871 2643 6PCD 6946 3AED .....6C...F.
000710 3777 796F 7E32 ED37 79CD 3946 3209 436F 7...2.7..9F2.C.
000720 3AEC 3707 7D32 E137 3008 2100 002B 7CB5 :.7..2.70.1..+.
000730 20FB E1C9 E607 0707 07F6 C732 4546 AFCD .....2EF..
000740 C7C9 CD00 46CD 6946 3AED 37BA ED53 EE37 ...F..F.7..S.7
000750 C83E 1AF5 CD69 46F1 32BC 37C9 CD58 46F5 >....P.2.7..XF.
000760 F100 0000 CDAC 43CB 47C8 18F8 3293 46E3 .....C.G..2.F.
000770 C546 237E 2332 D346 7E23 666F 22A7 46E1 .F0.02.F.0..F.
000780 E3CD 4746 CD69 46C5 D5E5 21BC 3736 0011 ..GP..F..1.76..
000790 EF37 C1C5 C1C5 F318 030F 300C 7ECB 4F28 .7.....0..0(O
0007A0 F8F3 0000 03C3 A146 F87E B67C 36D0 E1D1 .....F..6..
0007B0 C128 23CB 5720 13FE 2028 11F5 3E3F 3208 .(0.W...(.2.
0007C0 43CD 0046 3E0B CD58 46F1 10B5 473E 00CB C..F>..XF..G>..
0007D0 0038 033C 18F9 C1C9 3E08 CD71 460A 011A .8.<.....F..
0007E0 023E A8CD 7146 0509 0A12 3EA9 18F5 3E08 >..F.....>..
0007F0 CD71 4605 011A 0001 0542 44C3 0047 0139 ..F.....BD..G.9

```

Fig. 4. Full sector dump of TRSDOS 2.1, Track 0, Sector 7. Similar to TRSDOS 2.2, relative byte #52 has original value of 1BH rather than 1FH as in TRSDOS 2.2. The remaining byte is the same in both TRSDOS's.

```

000000 00FE 11F3 31FC 4121 E242 CD9A 423E 0132 ....1.A1.B..B>.2
000010 E137 3A02 4257 1E04 0100 4DCA AA42 2070 .71.BW....M..B..
000020 3A00 4DE6 1021 E542 2869 D92A 16AD 557C :.M..1.B(...*.MU.
000030 0707 07E6 0767 0707 045F 01FF 4DD9 CD75 .....M....
000040 423D 2017 CD75 4247 CD75 426F 05CD 7542 B>....BG..B...B
000050 6705 28EA CD75 4277 2318 F63D 2808 CD75 :(.B.0..B..(
000060 4247 CD75 4210 FB18 D5CD 7542 CD75 426F BG..B.....B..B.
000070 CD75 4267 E9D9 0C20 14C5 3001 32E1 37CD .B.....>.2.7.
000080 AA42 200C C11C 7BD6 0A20 025F 140A D9C9 .B.....>.2.7.
000090 21F1 42CD 9A42 CD40 0076 E57E F003 2808 1.B..B.0.....(
0000A0 CD33 0023 F00D 20F3 E1C9 C5CD B242 E1C8 .3.0.....B..
0000B0 444D ED53 EE37 21EC 3736 1BF5 F1F5 F17E DM.S.71.76.....
0000C0 0F38 FC36 00D5 11EF 37C5 C118 080F 300A .8.6....7.....0.
0000D0 70CB 4F28 F81A 0203 18F6 7EE6 5CD1 C836 .0(O.....6
0000E0 D0C9 1C1F 0317 E84E 4F20 5359 454D .....NO.SYSTEM
0000F0 0D17 E844 4953 4B20 4552 524F 520D E85F ...DISK.ERROR...

```

Fig. 5. Full sector dump of BOOTSYS, Track 0, Sector 0. Relative byte BAH is underlined. See footnote for more information on this modification.

fort if you try both of these access times out first. Some drives (Shugart, for example) are not capable of 10 ms access times, but can take 20 ms. Other drives (Percom, M.P.I., etc.) are capable of 5 ms access times.

Try the different times with your drives, and then Superzap the appropriate values onto your DOS diskettes. ■

Footnotes

* Recent information from APPARAT also mentions a third modification that is neces-

sary for this fix. It involves a change to 1 byte in the BOOTSYS module. This will make the BOOTSTRAP loader work at the higher step times also. This change may be made to TRSDOS 2.1, 2.2 or NEWDOS. In Track 0, Sector 0, change the relative byte BAH as follows: Retain original value (1FH in TRSDOS 2.2; 1BH in 2.1 and NEWDOS) for 40 ms step time. For 20 ms, change to 1AH. For 10 ms, change to 19H.

** Further information also indicates values for 5 ms step times (which may not work on other than MPI drives). For bytes that are changed in the 1BH, 1AH, 19H, sequence, 1BH will give 5 ms step times. For bytes that use the 0BH, 0AH, 09H sequence, 0BH gives 5 ms step time. Both values should correlate: If one byte is 1BH, the other should be 0BH. If one byte is 1AH, the other should be 0AH. Likewise for 19H; 09H, and 18H; 08H.

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The solution to a loopy problem.

The "Next" Trap

Hubert C. Borrmann
2840 South Circle Drive #209
Colorado Springs, CO 80906

I fell into the "NEXT" trap when I tried to run the big ROM and RAM test in appendix C of the Level II manual.

Have you fallen into this sneaky trap yet? If not, you surely will sooner or later. What astounds me is, that I have so far seen no reference to this, not even in the *Learning Level II* book by D. A. Lien. ?NF ERROR was looking at me from the screen.

If you want to fix this program, insert the following line:

```
280 X = 99: NEXT X
```

Level II is a good interpreter, but reminds me of one of my teachers many many years ago who had an astounding memory for things that should have been

forgotten. To explain this, type Listing 1, RUN and type 10.

OK, this is the way it should work. Now RUN it and type in a 5.

NF ERROR

Unfinished Business

This is a simple program, containing three FOR-NEXT loops. The first one in line 30 and 40,

The program then enters two nested loops and everything

works fine until the Variable B is checked in line 110; where B should be changed from one or two for the second pass through the B-loop. But the interpreter won't let you do this and out executes nine times unless your entered number makes you jump out of the loop to line 50, and the loop will not run its course, leaving behind "unfinished business." (This is what the interpreter remembers, but should have forgotten.)

comes the message ?NF ERROR IN 110.

You see, the interpreter remembers that unfinished business with Variable A and won't accept NEXT B until A is cleared. You know that a NEXT statement will let the program fall through if the variable involved is larger than the TO figure given in the FOR-TO statement. The NEXT statement adjusts the variable and then makes this test. So, fortunately our fix is easy for situations where you jump out of FOR-NEXT loops. Insert this line in our little program, and we are in business:

```
55 A = 999: NEXT A
```

Now RUN and type a 5.

Don't be misled if you enter the number 9! It still jumps out of the loop! I hope that this may clear up some unexplained phenomena and help you avoid the NEXT trap. ■

```
10 CLEAR 200 : CLS
20 PRINT@ 120, "INSTRUCTIONS # 1"
30 S1$="PRESS 'SPACE' WHEN READY"
40 GOSUB 10000
50 CLS : PRINT@ 512, "INSTRUCTIONS # 2"
60 SA=640
70 GOSUB 10100
80 CLS : PRINT@ 0, "AND MORE INSTRUCTIONS"
90 S1$="TYPE 'SPACE'-BAR TO CONTINUE, 'E' TO END"
100 GOSUB 10000
110 IF S6$="E" THEN END ELSE 20
```

Program Listing

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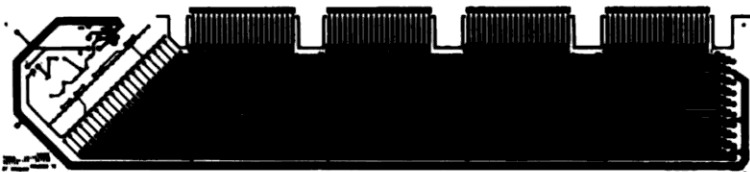
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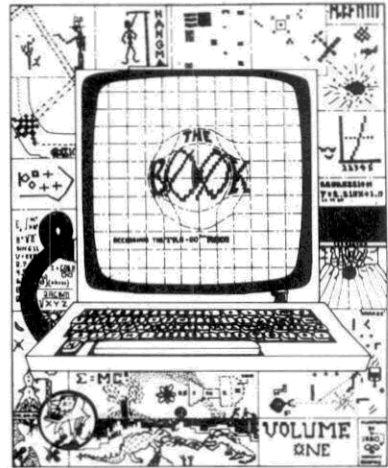


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The Competition's Cursor

R. Daniel Bishop
Department of Chemistry
The School of the Ozarks
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Surely you know how it is when you select one gadget or machine from among a variety of competing models, wishing all the while that the model you chose had some of those dandy options offered by the competition. Buying a microcomputer requires choices and compromises, and even though I felt the TRS-80 had enough of the options I wanted in a microcomputer, I still found myself taking sidelong glances at that infernal, insistent flashing cursor that the competition offered.

Well, those feelings are a thing of the past, because now I can write my own flashing cursor into TRS-80 Level II BASIC programs.

INKEY\$ Command

The key to the flashing cursor is the INKEY\$ command and the graphics character printed out by the CHR\$(143) command. While writing the main program, you need to determine the display position (0 to 1023) where the blip is supposed to appear each time it is used. Assign the value of this position to the variable CR and then use a GOSUB 1000 to transfer to the Flashing Cursor Subroutine (Listing 1).

Each character in the input string is stored sequentially in the N\$(j) array while the counter J keeps track of how many characters have been typed.

Once the enter key is depressed, the subroutine is transferred to the loop (lines 1012 to 1015) which adds these characters one at a time onto the string variable N\$, so that the complete input information can be used later in the program.

CR is incremented by one after each keyboard entry except when the backspace or the enter keys are depressed (having ASCII values of 8 and 13, respectively). The flashing cursor moves one more space, awaiting the next input.

A simple program, using this routine, follows:

```
1 CLEAR 500
2 DIM N$(30)
5 CLS
10 PRINT "WHAT IS YOUR
  NAME?"
15 CR = 20
20 J = 0
25 GOSUB 1000
30 PRINT
35 PRINT "I AM VERY GLAD TO
  MEET YOU, "N$;"
40 END
```

In addition to specifying the starting cursor position, CR, in the main program, the input counter J must be initialized, and the array N\$(J) is DIMensioned. The four lines, 2, 15, 20 and 25, take the place of the usual INPUT N\$ statement. Note that the input N\$ is returned as a character string. However, since INKEY\$ was used to construct this character string, commas and quotation marks can all be used as valid input. The enter key is the only string delimiter that is recognized. If the input is used as numeric data, one additional instruction, 27 N = VAL(N\$), must be inserted.

If only a single letter or number is to serve as the total input, as in selecting an option from a menu, the flashing cursor subroutine can be streamlined using only lines 1000 through 1005 and adding 1006 RETURN.

The input character is re-

turned in this case as R\$ rather than N\$. This requires little more memory than INKEY\$ normally uses and provides a far superior visual addition to the program.

Natural Restrictions

There are some natural restrictions imposed by using this routine in place of the INPUT command. The first is that the routine slows down keyboard response. A rapid-fire touch typist would go crazy trying to slow down to the computer's speed.

A second limitation is the size of the N\$(J) array. Obviously, if an input string exceeds the array size chosen, the program crashes. Also, although the same array may be used (without clearing) for all input in the program, it still consumes some memory which may be put to better use.

A way around this problem is to use the video monitor as the array and read these characters directly from the display, adding them one at a time to N\$. The routine that performs this task is a simple loop using the PEEK function.

```
1012 N$ = "": CR = CR - J
1013 FOR I = 15360 + CR TO 15360
  + CR + J
1014 N$ = N$ + CHR$(PEEK(I))
1015 NEXT I
1016 RETURN
```

This loop replaces lines 1012-1016 in Listing 1. Line 1009 can be deleted and :N\$(J) = " " in line 999 should be removed. This allows lines 1 and 2 in the main program to also be removed. All other lines remain the same. ■

```
998 END
999 J=J-1: IF J>=0 THEN CR=CR-1: N$(J)="" ELSE J=J+1
1000 PRINT@CR, CHR$(143)
1001 FOR I=1 TO 5: NEXT I
1002 PRINT@CR, " "
1003 FOR I=1 TO 5: NEXT I
1004 R$=INKEY$
1005 IF LEN(R$)=0 THEN 1000
1006 IF ASC(R$)=13 THEN 1012
1007 IF ASC(R$)=8 THEN 999
1008 PRINT@CR, R$
1009 N$(J)=R$
1010 CR=CR+1
1011 J=J+1: GOTO 1000
1012 N$=""
1013 FOR I=0 TO J-1
1014   N$=N$+N$(I)
1015 NEXT I
1016 RETURN
```

Program Listing 1



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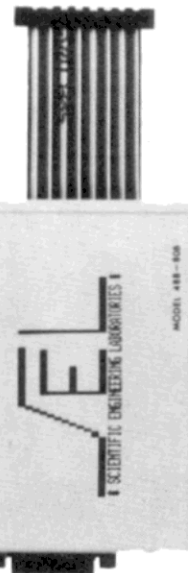
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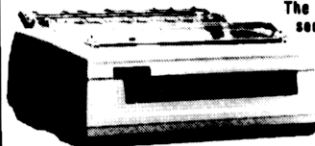
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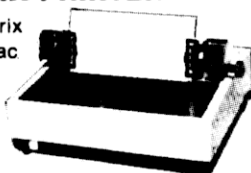
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As a regional sales manager with a major consumer products company, I am constantly challenged with finding new and creative ways of filling the product pipeline between my company and the consumer. This pipeline, or channel of distribution, consists of depart-

ment stores.

The way a store projects its future sales and determines the stock needed to support those sales is a basic financial planning concept, applicable to large or small businesses.

Our company now furnishes a stock and sales plan designed to maximize profits, as well as a profitability and return on investment analysis. These reports are generated on my TRS-80, and this article covers the planning process and its application.

The Retail Season

Retailers periodically go through a planning process forecasting sales for a given

period of time, called a season. Normally a season runs six months and is referred to as a "spring" or "fall" season. Whether the sales forecast is done with linear regression, exponential smoothing, S.O.T.P. (seat of the pants), or any other means, the end result is that merchandise must be purchased in advance of planned sales. The control and management of the flow of inventory through a retailer determines whether or not a profit is made.

Plans are normally drafted for both seasons and the fiscal year. A turnover ratio of stock to sales is predetermined, based on the needs of both the retailer and the vendors involved. In a simplified way, turnover is the number of times an average inventory will replace itself as it is sold.

As an example, if over a six

month period, or season, sales were \$10,000, with an average inventory of \$8,000, the turnover ratio would be 1.25 for the season. The turnover ratio is critical. Too fast a turnover means in all probability sales were lost as a result of being out of stock, while too slow a turnover can eat into profit and increase your overhead. Generally, the faster the turnover, the greater the profit.

Two Seasons

In my business, we work on two seasons a year, which go from February to July and August to January. The average inventory turnover is 3.0 per year, or 1.4 turns in the spring and 1.6 in the fall.

The following program determines monthly stock levels and planned purchases needed to maintain stock levels. A sales

WHAT YEAR IS THE PLAN FOR (YY) ? 80
WHAT IS THE CHAIN'S NAME ? ANY STORE
WHAT IS THE BRANCH/DOOR'S NAME ? MAIN ST.
WHICH SEASON WILL THIS PLAN COVER (FALL OR SPRING) SPRING

ENTER THE 79 SALES FOLLOWED BY A COMMA, THEN THE 80 SALES
79/80 SALES FOR FEB? 11.1,12.2
79/80 SALES FOR MAR? 10.9,13.1
79/80 SALES FOR APR? 11.5,10.7
79/80 SALES FOR MAY? 12.4,15.2
79/80 SALES FOR JUN? 9.2,9.9
79/80 SALES FOR JUL? 11.6,11.9

PLANNED SEASON TURN? 1.39
IF YOU HAVE AN ACTUAL BOM ENTER IT.
IF YOU DO NOT PRESS ENTER ?_

Example 1.

- 1980 STOCK/SALES PLAN FOR ANY STORE - MAIN ST.

	FEB	MAR	APR	MAY	JUN	JULY	TOT
79 SALES	11.1	10.9	11.5	12.4	9.2	11.6	66.7
80 SALES	12.2	13.1	10.7	15.2	9.9	11.9	73.0
BOM	52.6						
EOM	53.5	51.1	55.6	50.3	52.3	52.5	
OTR	13.1	10.7	15.2	9.9	11.9	12.2	
TURN 1.39	AVG INV 52.5		TOTAL SALES 73.0		+ 9%		

Example 2.

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history for the prior period is shown, along with the B.O.M. (beginning of month) inventory, the E.O.M. (end of month) inventory, and the allowed monthly receipts or O.T.R. (open to receive).

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Program Listing

```
100 CLEAR 1000 : CLS
110 REM * STOCK AND SALES PLANNING
120 REM * BILL VICK / 1/30/80
130 REM * (214) 596-0533
140 PRINT TAB(20)"STOCK & SALES PLANNING"
150 PRINT TAB(25)"BY BILL VICK"
160 PRINT TAB(22)"ALL RIGHTS RESERVED"
170 FOR T=1 TO 500 : NEXT T
180 DIM M(13), MS(13), EOM(13), Z$(2), OTB(13), S(13)
190 RESTORE : CLS
200 INPUT"WHAT YEAR IS THE PLAN FOR (YY) " ; YEARS
210 YEARS$=RIGHT$(YEARS, 2) : YEAR=VAL(YEARS$) : LYEAR=YEA
AR-1
220 INPUT"WHAT IS THE CHAINS NAME " ; CHAINS
230 INPUT"WHAT IS THE BRANCH/DOOR'S NAME " ; BRANCHS
240 FOR M=0 TO 12 : READ MS(M) : NEXT : REM * READ IN
MONTHS
250 DATA JAN, FEB, MAR, APR, MAY, JUN, JULY, AUG, SEP, O
CT, NOV, DEC, JAN
260 PRINT"WHICH SEASON WILL THIS PLAN COVER (FALL OR SP
RING) " ;
270 GOSUB 820 : REM * INKEY SUBROUTINE
280 IF KBS="S" THEN PRINT"SPRING" ELSE PRINT"FALL"
290 PRINT
300 IF KBS="S" THEN SB=1 : SE=6 : S=1 : GOTO 330
310 IF KBS="F" THEN SB=7 : SE=12 : S=2 : GOTO 330
320 IF KBS<>"S" OR KBS<>"F" THEN CLS : GOTO 260
330 PRINT"ENTER THE " ; LYEAR ; " SALES FOLLOWED BY A COMMA
, THEN THE " ; YEAR ; " SALES"
340 FOR T=SB TO SE
350 PRINT LYEAR ; "/" ; YEAR ; " SALES FOR " ; MS(T) ;
360 INPUT S(T), M(T)
370 ST=ST+S(T) : REM * TOTALS SALES THIS YEAR
380 TS=TS+M(T) : REM * TOTALS SALES LAST YEAR
390 NEXT
400 AV=(INT(TS-ST)/ST)*100 : REM * PERCENT INCREASE
IN SALES
410 PRINT : INPUT"PLANNED SEASON TURN";TURN
420 PRINT"IF YOU HAVE AN ACTUAL BOM ENTER IT."
430 INPUT"IF YOU DO NOT PRESS ENTER " ; BOM
440 AS=TS/6 : REM * AVERAGE MO SALES=TOTAL SALES/SI
```

```
X MONTHS
450 AI=TS/TURN : REM * AVERAGE INVENTORY=TOTAL SALES
/PLANNED TURN
460 IF BOM<=0 THEN 470 ELSE 480
470 IF M(SB)>AS THEN BOM=(M(SB)-AS)+AI ELSE BOM=(AS-M(S
B))+AI
480 Z$(1)=" FEB MAR APR MAY J
UN JULY TOT"
490 Z$(2)=" AUG SEP OCT NOV D
EC JAN TOT"
500 NS=" EOM ###.0 ###.0 ###.0 ###.0
###.0 "
510 BY$=" OTR ###.0 ###.0 ###.0 ###.0
###.0 "
520 OS=" BOM ###.0 "
530 RS=" ## SALES ###.0 ###.0 ###.0 ###.0
###.0 ###.0 "
540 LS=" ## SALES ###.0 ###.0 ###.0 ###.0
###.0 ###.0 "
550 QS=" TURN ##.## AVG INV ###.0 TOTAL SALES
###.0 +####"
560 FOR T=SB TO SE-1 : REM * COMPUTES END OF MONTH
INVENTORY
570 EOM(T)=(M(T+1)-AS)+AI
580 EOM=EOM+EOM(T) : REM * TOTALS EOM FOR SEASON
590 NEXT
600 CN=(AI*7)-(BOM+EOM) : REM * COMPUTES ENDING PERIO
D INVENTORY
610 EOM(SE)=CN
620 YEAR=YEAR+1900
630 CLS : PRINT YEAR ; " STOCK/SALES PLAN FOR " ; CHAINS ;
" " ; BRANCHS
640 YEAR=YEAR-1900
650 PRINT
660 PRINT Z$(S)
670 PRINT
680 PRINT USING L$ ; LYEAR, S(SB), S(SB+1), S(SB+2), S(S
B+3), S(SB+4), S(SB+5), ST
690 PRINT USING RS ; YEAR, M(SB), M(SB+1), M(SB+2), M(SB
+3), M(SB+4), M(SB+5), TS
700 PRINT : PRINT USING OS ; BOM
710 PRINT USING NS ; EOM(SB), EOM(SB+1), EOM(SB+2), EOM(
SB+3), EOM(SB+4), EOM(SB+5)
720 PRINT : PRINT USING BY$ ; M(SB+1), M(SB+2), M(SB+3),
M(SB+4), M(SB+5), M(SB)
730 PRINT
740 AI=(EOM+EOM(SE)+BOM)/7 : REM * AVERAGE INVENTORY

750 PRINT USING QS ; TURN, AI, TS, AV
760 PRINT : GOSUB 840
770 PRINT" DO YOU WANT TO TO PRINT THIS (Y/N) "
780 GOSUB 820 : REM * INKEY SUBROUTINE
790 IF LEFT$(KBS, 1)="Y" THEN GOSUB 850 : GOTO 620 : RE
M * IF YES LPRINTS
800 IF KBS="N" THEN 190 : REM * IF NO RERUNS PROGRAM

810 IF KBS<>"N" OR KBS<>"Y" THEN 770
820 KBS=INKEY$ : IF KBS=" " THEN 820 ELSE 830 : REM *
INKEY ROUTINE
830 KB=VAL(KBS) : RETURN
840 POKE 16414, 88 : POKE 16415, 4 : RETURN : REM * L
PRINT TO PRINT
850 POKE 16414, 141 : POKE 16415, 5 : RETURN : REM *
PRINT TO LPRINT
```



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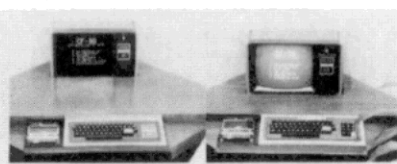
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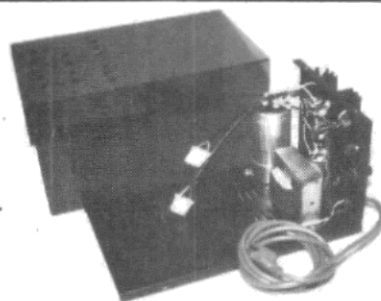
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Ping-Pong

Ronald Moehlis
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This article contains five short programs to demonstrate the SET, RESET, POINT and INKEY\$ features of the TRS-80 computer with Level II BASIC. The sequence of programs begins with a dot moving across the screen and each subsequent program adds additional instructions until you find yourself playing pong.

Program Listing 1 moves a dot horizontally across the

screen. To plot a point with coordinates (X,Y) use SET(X,Y). The X value must range from 0 to 127 and the Y value from 0 to 47.

Statement 30 displays the dot before it is turned off by the RESET in statement 40. Statement 60 determines if the dot has reached the right edge of the screen and moves it back to the left edge.

Program Listing 2 adds two vertical "walls" in statement 6. When the dot reaches a wall it bounces in the opposite direction. Line 60 checks for this and line 68 changes the direction. Line 60 could be

IF POINT(X,25) THEN 68

which demonstrates the POINT feature. If the wall is directly ahead of the dot POINT(X,25) is TRUE; otherwise it is FALSE.

Program Listing 3 moves the dot diagonally and bounces it off walls in a rectangular box. Line 6 is modified and line 11 is

added to provide the other walls. Since the dot now moves in two directions, the position variable Y and its increment variable K, is added to the program.

The paddles which can be moved to deflect the dot, are added in Program Listing 4. Also INKEY\$ is added in statement 41 to allow real-time paddle action.

The O and L keys control the right paddle, while Q and A keys control the left. Statements 100 and 120 move the right paddle and statements 130 and 140 the left paddle.

Variable O is the Y value of the upper edge of the right paddle. L is the Y value of the lower edge. Q and A serve the same functions for the left paddle. Lines 55 and 63 determine if the dot has hit a paddle. If so, position variables X or Y change.

Program Listing 5 is the simple Pong game. Statements 53, 54, 60 and 61 determine if the dot is beyond the paddle. If so, a point is added to either score—variable RR or LL in lines 80 to 90. Now line 12 provides for a dot to appear at random from the top wall after a score.

Note that in the programs with the paddles, the movement of the dot is slower. This is because statements are executed to move the paddles.

More elaborate Pong programs can, of course, be written, but this set of programs demonstrates the idea to a beginner. ■

Note: Sound effects can be added to Pong using Babybeep by Dennis Kitz. See *80 Microcomputing*, April, 1980.

```
1 REM PROGRAM 1
2 REM MOVEMENT OF A DOT
3 CLS
4 X=0
5 SET(X,25)
6 FOR I=1 TO 5:NEXT I
7 RESET(X,25)
8 X=X+1
9 IF X>127 THEN X=0
10 GOTO 2
```

Program Listing 1.

```
1 REM PROGRAM 2
2 REM DOT BOUNCING OFF WALLS
3 CLS
4 FOR Y=0 TO 47:SET(0,Y):SET(127,Y):NEXT Y
5 C=1
6 X=1
7 SET(X,25)
8 FOR I=1 TO 5:NEXT I
9 RESET(X,25)
10 X=X+C
11 IF X>126 OR X<1 THEN 68
12 GOTO 20
13 C=-C
14 GOTO 50
```

Program Listing 2.

```
1 REM PROGRAM 3
2 REM DOT BOUNCING IN A RECTANGULAR BOX
3 CLS
4 FOR Y=9 TO 39:SET(0,Y):SET(127,Y):NEXT Y
5 C=1
6 Y=10
7 K=1
8 FOR X=1 TO 126:SET(X,9):SET(X,39):NEXT X
9 X=1
10 SET(X,Y)
11 FOR I=1 TO 5:NEXT I
12 RESET(X,Y)
13 X=X+C
14 Y=Y+K
15 IF Y<9 AND Y>39 THEN 60
16 GOTO 66
17 IF X>126 OR X<1 THEN 68
18 GOTO 20
19 K=-K
20 GOTO 51
21 C=-C
22 GOTO 50
```

Program Listing 3.

```

1 REM PROGRAM 4
2 REM DOT BOUNCING IN A RECTANGULAR BOX WITH PADDLES
3 Q=20:A=25
4 L=25:O=20
5 CLS
6 FOR Y=9 TO 39:SET(0,Y):SET(127,Y):NEXT Y
7 C=1
8 Y=10
9 K=1
10 FOR I=20 TO 25:SET(7,I):SET(120,I):NEXT I
11 FOR X=1 TO 126:SET(X,9):SET(X,39):NEXT X
12 X=1
20 SET(X,Y)
30 FOR I=1 TO 5:NEXT I
40 RESET(X,Y)
41 AS=INKEYS
42 IF AS="" THEN 50
44 IF AS="O" THEN GOSUB 100
45 IF AS="L" THEN GOSUB 120
46 IF AS="Q" THEN GOSUB 130
47 IF AS="A" THEN GOSUB 140
50 X=X+C
51 Y=Y+K
53 IF Y<39 AND Y>9 THEN 60
55 IF POINT(X,Y) THEN 66
60 IF X>126 OR X<1 THEN 68
63 IF POINT(X,Y) THEN 68
65 GOTO 20
66 K=-K
67 GOTO 51
68 C=-C
70 GOTO 50
100 RESET(120,L):O=O-1:L=L-1:SET(120,O):RETURN
120 RESET(120,O):O=O+1:L=L+1:SET(120,L):RETURN
130 RESET(7,A):Q=Q-1:A=A-1:SET(7,Q):RETURN
140 RESET(7,Q):Q=Q+1:A=A+1:SET(7,A):RETURN

```

Program Listing 4.

```

1 REM PROGRAM 5
2 REM PONG
3 Q=20:A=25
4 L=25:O=20
5 CLS:LL=0:RR=0:PRINT@132,LL;:PRINT@186,RR
6 FOR Y=9 TO 39:SET(0,Y):SET(127,Y):NEXT Y
7 C=1
8 PRINT@158,"PONG";
9 K=1
10 FOR I=20 TO 25:SET(7,I):SET(120,I):NEXT I
11 FOR X=1 TO 126:SET(X,9):SET(X,39):NEXT X
12 Y=10:X=RND(100)+10
20 SET(X,Y)
30 FOR I=1 TO 5:NEXT I
40 RESET(X,Y)
41 AS=INKEYS
42 IF AS="" THEN 50
44 IF AS="O" THEN GOSUB 100
45 IF AS="L" THEN GOSUB 120
46 IF AS="Q" THEN GOSUB 130
47 IF AS="A" THEN GOSUB 140
50 X=X+C
51 Y=Y+K
52 IF Y<39 AND Y>9 THEN 60
53 IF X>122 THEN 90
54 IF X<6 THEN 80
55 IF POINT(X,Y) THEN 66
60 IF X>122 THEN 90
61 IF X<5 THEN 80
63 IF POINT(X,Y) THEN 68
65 GOTO 20
66 K=-K
67 GOTO 51
68 C=-C
70 GOTO 50
80 RR=RR+1:IF RR>15 THEN 96
85 PRINT@186,RR;:GOTO12
90 LL=LL+1:IF LL>15 THEN 96
95 PRINT@132,LL;:GOTO12
96 PRINT@970,"":INPUT"PLAY AGAIN";BS
97 IF LEFT$(BS,1)="Y" THEN 5 ELSE END
100 RESET(120,L):O=O-1:L=L-1:SET(120,O):RETURN
120 RESET(120,O):O=O+1:L=L+1:SET(120,L):RETURN
130 RESET(7,A):Q=Q-1:A=A-1:SET(7,Q):RETURN
140 RESET(7,Q):Q=Q+1:A=A+1:SET(7,A):RETURN

```

Program Listing 5.

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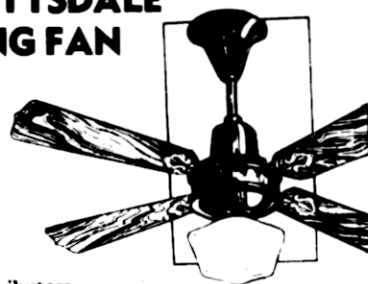
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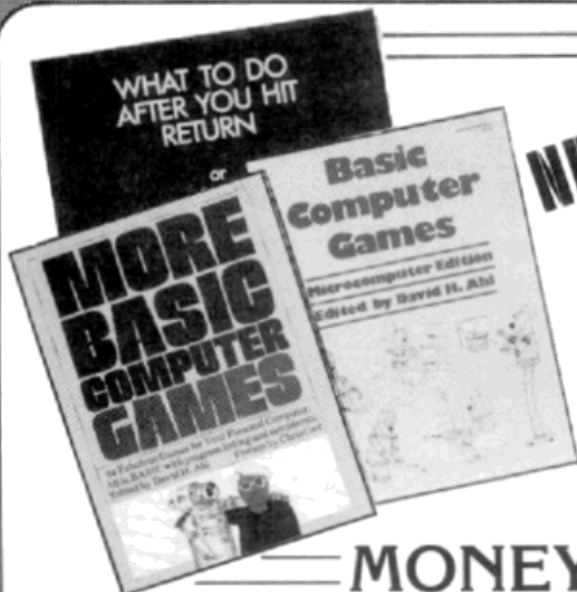
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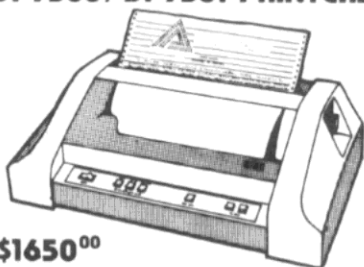
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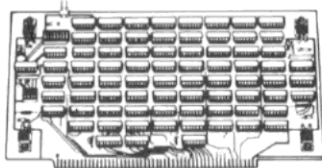
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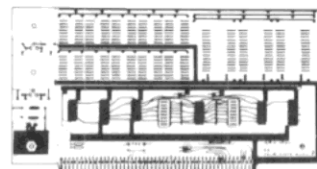
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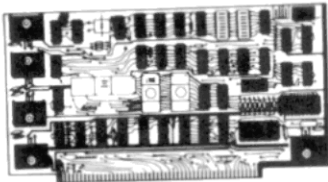
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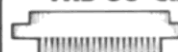
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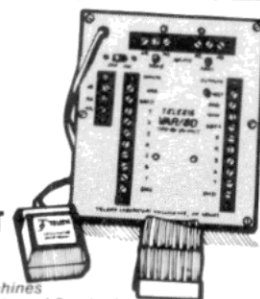
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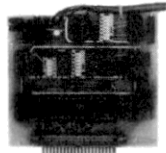
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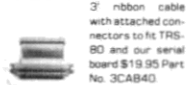
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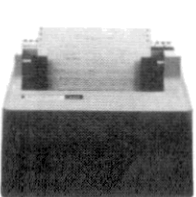
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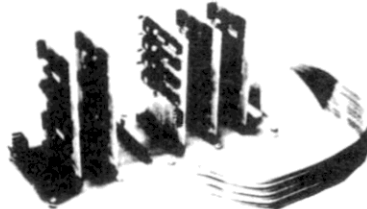
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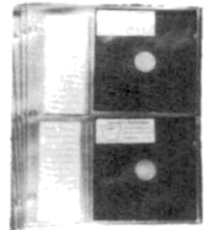
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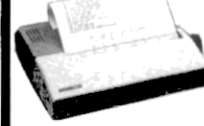
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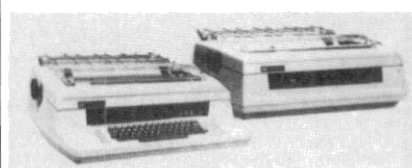


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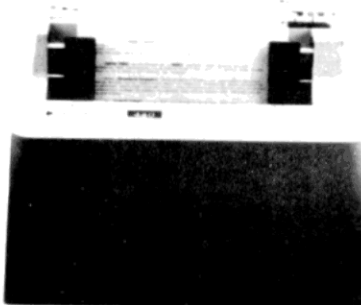
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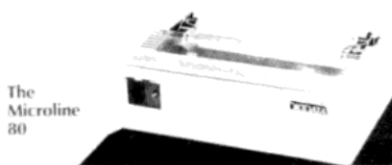
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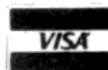
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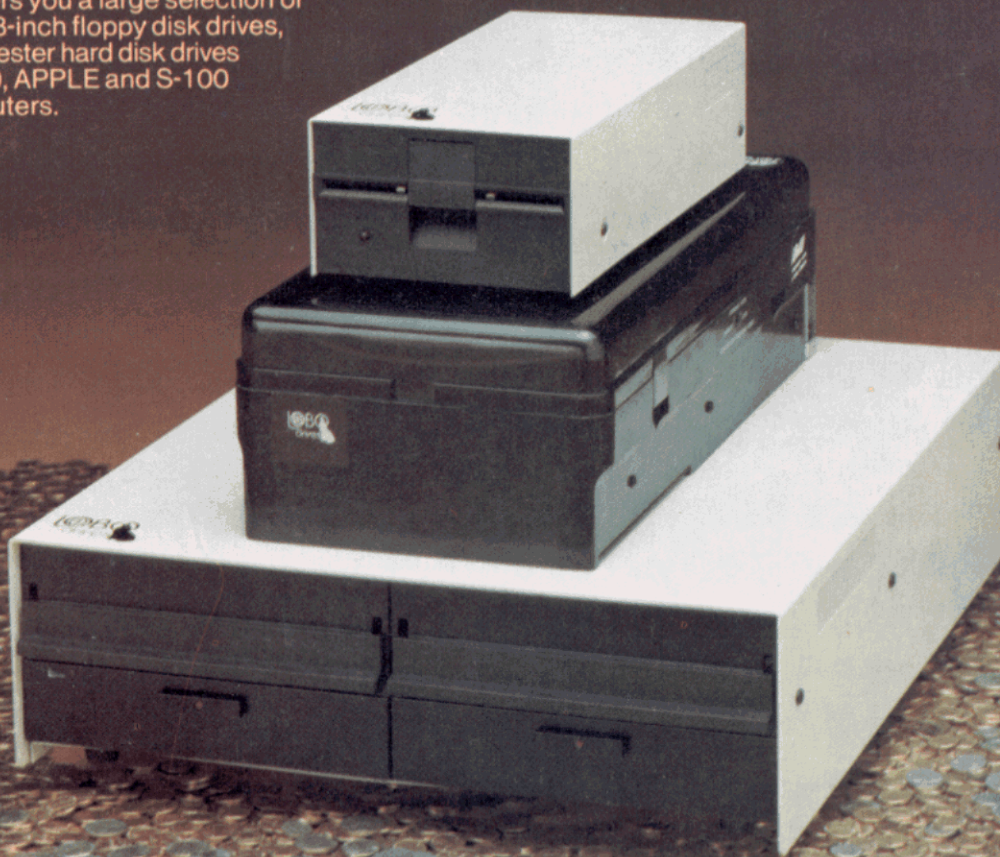


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Recommended initial purchase:

Exatron Stringy Floppy	\$249.50
3 Wafers each: 5', 10', 20', 50'	40.00
Bus Extender, 2-for-1	15.00
ESF Machine Language Monitor	9.95
Wafer Organizer	5.00

\$319.45

SPECIAL PRICE FOR THIS STARTER KIT

\$299.50

Sales Tax (California only)

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TOTAL

For more information see the current Exatron Stringy Floppy Owners Association Newsletter in *Microcomputing*.

If you have any questions about the product, about Exatron, or ESFOA, please call the Hot Line. Address letters to ESFOA, 3559 Ryder St., Santa Clara, CA 95051.

Stringy Floppy is a trademark of Exatron Corporation.

HOT LINE (For Calls Outside CA)

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